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THIRD ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE

AGRICULTURAL EXPERIMENT STATION,

AT

AMHERST, MASS.

1885.

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AGRICULTURAL EXPERIMENT STATION,

AT AMHERST, MASS.

BOARD OF CONTROL, 1885.

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David Wentzell, ... *Farmer.*

AMHERST, Jan. 12, 1886.

To the Honorable Senate and House of Representatives.

The Third Annual Report of the Board of Control of the State Agricultural Experiment Station at Amherst, for the year 1885, is herewith submitted, in accordance with the provisions of chapter 212 of the Acts of the year 1882, and chapter 369 of the Acts of the year 1885.

O. B. HADWEN,
Secretary.

THIRD ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The history of the third year of actual work at the Experiment Station shows some progress in various directions. The recently increased appropriation by the State has rendered it an easier task than heretofore to secure a reasonable success of the new institution.

Desirable changes and improvements in the fitting up of the various farm buildings for special purposes, as well as a more thorough system of general cultivation of the entire area of land at the disposal of the Station, can at present be better attended to; and the subjects for investigation may hereafter be chosen, in part at least, more freely with reference to immediate practical utility, and in such directions as the interest of the farming community may point out.

The plans for experiments which were from time to time during the past year submitted to your consideration for endorsement have been carried out to the full extent of the temporary means on hand. Feeding experiments with milch cows and with pigs have been carried on without much interruption during the entire year. One experiment with cows, extending over a period of six months, to test the feeding value of corn ensilage as compared with other customary ingredients of a suitable winter diet for dairy stock, and one experiment with pigs to ascertain the relative feeding effect of skim milk and creamery buttermilk, when fed in connection with corn meal, are farther on reported. Others not yet fully finished will be published in due time.

The work in the field has been more extensive and more varied than in previous years. From four to five acres of worn-out grass land have been turned over. Part of it was ploughed early in the spring, and subsequently, after manuring, planted with fodder corn for ensilage. The remainder was added, after harvesting the hay crop, to the experimental plats for the cultivation of prominent forage crops.

The experimental portion of the field work during the past year has been described in subsequent pages under the following headings : —

1. Fodder corn raised upon underdrained and exhausted lands, partly manured with one single article of plant food, partly without the use of any manurial matter.
2. Influence of fertilizers on the quantity and the quality of some prominent fodder crops.
3. Fodder corn for silos.
4. Observations concerning the adaptation of some prominent fodder crops new to our section of the country.
5. Experiments with potatoes.
6. Experiments with root crops.
7. Miscellaneous field observations.

Some of these experiments are continuations of investigations inaugurated in previous years ; others are new additions, and are more or less relating to the question of an increased economical supply of fodder, and the relative nutritive character of prominent farm crops.

The examination of fruits with reference to their mineral constituents, for the purpose of assisting in the introduction of a rational system of manuring large and small fruit-bearing plants, has been continued. In this connection several prominent varieties of apples, and of samples of apple pomace, have been tested regarding their value as fodder for farm live stock. More extensive grounds have been rented from the college for a new orchard, to improve the chance for studying the relation between healthy and diseased fruit-bearing plants.

The local weather observations have been continued, although the direct supply of the farmers' bulletins of the Signal Service Bureau have been withdrawn.

The work in the chemical laboratory has been quite ex-

tensive. Aside from a large number of analyses carried on in connection with the feeding experiments, many analyses of fodder articles, of refuse materials from factories of various descriptions, of agricultural chemicals, of commercial fertilizers, and of samples of well water sent on from different parts of the State, have been made at the request of officers of farmers' clubs.

In sight of the steadily increasing demand in this direction on the Station, it is very desirable, in the interest of good economy and efficient work, that the completion of the new laboratory of the Station should be brought about at as early a date as possible.

The interest of the farming community in the work of the Station seems to be steadily increasing, judging from the character of an extensive correspondence, as well as the frequent applications for its periodical publications. The number of copies of each bulletin had to be raised of late to three thousand and five hundred.

The assistance received from all parties connected with the work of the Station, in the laboratory and in the field, has been very satisfactory.

In conclusion, permit me to express my sincere thanks to you for the hearty support and kind indulgence I have en joyed in the fulfilment of my duties.

I am, very respectfully,

C. A. GOESSMANN,
Director of the State Agricultural Experiment Station.

AMHERST, MASS., Jan. 12, 1886.

FEEDING EXPERIMENTS.

C. A. GOESSMANN.

Feeding Experiments with Milch Cows.

The experiments below described were carried on for the purpose of ascertaining, under otherwise fairly corresponding circumstances, the economy of several customary combinations of fodder articles, as far as the cost of the feed and the quantity and quality of milk obtained is concerned. The observations began on the 1st of November, 1884, and were continued until the 18th of April, 1885, extending thus over a term of nearly six months.

Two cows, — Lady Horace (grade Ayrshire) and Bessie (grade Jersey), — both from seven to eight years old, and of a corresponding milking period, served for the trial. The last calf had been dropped between the 16th and 18th of October, 1884.

Hay, corn fodder, corn ensilage, corn meal, wheat bran and gluten meal constituted the ingredients for the compounding of the daily diet; they were fed periodically, in varying proportions and in different combinations, to notice their comparative individual merits, if any should become conspicuous. The same weights of corn meal, gluten meal and wheat bran, whenever used, were retained throughout the entire experiments; whilst the weight of the hay, corn fodder and corn ensilage was altered in consequence of being fed either alone or in some particular combination with each other. The entire amount of these articles consumed under both conditions was limited in every instance by the inclination of the animal. The first feeding took place between six and seven o'clock in the morning, the second at noon, and the third at six o'clock in the evening. Corn meal, wheat bran and gluten meal were usually fed, together with

a small amount of the coarser feed, during milking, morning and evening, whilst the remainder of the coarser feed was offered subsequently three times during the day. The amount left over was weighed and deducted from the previous record. The price which has been adopted in our subsequent valuation of each article of fodder used during the experiments is based on our local condition of the market, and does not directly apply to more favored localities. The cost of one quart of milk, as stated below, may vary thus, in case of the same kind and the same amount of feed and of a corresponding yield of milk, from that in other localities. Whilst our statements of cost of feed for the production of one quart of milk can only claim a direct application for a limited locality, it will be conceded that the statement of relative cost of the milk, in case of different combinations of fodder articles for its production, may fairly claim a more general consideration. The following rates of prices have been adopted in our subsequent valuation per ton of two thousand pounds: Corn meal and wheat bran, $23.00; gluten meal, $22.50; hay, $15.00; dry corn fodder, $5.00; corn ensilage, $2.75. The price of the latter is based on the following circumstances: well-dried corn fodder contains 20 per cent. of moisture and 80 per cent. of dry vegetable matter; green corn fodder, adapted to the production of ensilage, contains from 18 to 22 per cent. of vegetable matter, and 78 to 82 per cent. of moisture. Four tons of such green fodder corn will produce one ton of dry corn fodder, as described. Counting one ton of green corn fodder worth $1.25, and the cost of converting it into ensilage equal to $1.50, — a rather liberal allowance, — one ton of corn ensilage would be worth $2.75. As the relative nutritive value of a fodder article, in case of the same kind and condition of the animal, depends, aside from its general adaptation, on its actual percentage of dry vegetable matter, and on the particular relative proportion of its nitrogenous (protein) and non-nitrogenous constituents, the total amount of dry vegetable matter contained in the entire daily diet during each feeding period has been stated, alongside of the daily yield of milk. The relative proportion of digestible nitrogenous and non-

nitrogenous constituents of the feed is expressed by "Nutritive Ratio" taking nitrogen=1. This mode of reporting our observations has been adopted for the purpose of assisting the reader in the recognition of the amount of dry matter consumed daily by each cow during each period of feeding; and of rendering more conspicuous the effect of each particular combination of fodder articles on the daily yield of milk, as well as the general condition of the animals on trial.

The weights of the latter were ascertained once each week before milking and feeding in the morning. Lady Horace weighs at present 950 pounds, and Bessie 822 pounds, which is approximately the same as at the beginning of the experiments. The former yields at present from 23 to 24 pounds of milk per day, and the latter from 21 to 22 pounds, with a daily diet consisting of the same amount of hay, corn meal and wheat bran, which constituted the daily feed during the first feeding period (November 1–10). The decline of milk production (independent of kind and amount of feed), in consequence of the progress of the milking period (since November 1), amounts apparently to nine pounds per day in the case of both cows. The results obtained confirm, in several directions, those reported in previous bulletins (see Nos. 10–11–12; also Second Annual Report, p. 36.) They show the good service of wheat bran and gluten meal as constituents of the daily diet of milch cows, and also the favorable influence of good corn ensilage on the flow of milk, comparing pound for pound of dry vegetable matter fed with the yield of milk; yet it is not less apparent that a too exclusive feeding of corn ensilage affects seriously the general condition of the animal. No serious alteration in the composition of the milk obtained under such conditions has thus far been noticed; our samples of milk compared well with the best we have tested from other feed.

I. Record of Lady Horace.

Feeding Periods.	Feed Consumed (lbs.) per day.						Milk Produced (lbs.) per day.			Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Nutritive Ratio.	Weight of Animal.
	Wheat Shorts.	Corn Meal.	Gluten Meal.	Hay.	Corn Fodder.	Corn Ensilage (cut).	Morning.	Evening.	Total.			
Nov. 1 to 10,	3.25	3.25	–	20.	–	–	19.3	15.7	35.	23.63	1:8.11	930
10 to 17,	3.25	3.25	–	20.	–	–	17.1	14.0	31.1	23.63		900
18 to 24,	3.25	3.25	–	17.4	–	–	15.4	13.5	28 9	21 30	1:7.99	905
25 to Dec. 1,	3.25	3.25	–	18.9	–	–	17 2	13.4	30.6	22.65		985
Dec. 4 to 13,	3.25	3.25	3.25	19.	–	–	18.1	14.4	32.5	25.61	1:6.53	992
14 to 23,	3.25	3.25	3.25	8.3	8.3	–	17.2	12.4	29.6	23.75	1:5.79	944
24 to Jan. 2,	3.25	3.25	–	10.1	10.1	–	15.4	10.9	26.3	24.17		1015
Jan. 2 to 12,	3.25	3.25	–	10.3	10.3	–	14.2	10.	24.2	24.53	1:7.01	996
13 to 22,	3.25	3.25	–	10.7	10.7	–	13.9	10 2	24.1	25.27		1004
27 to Feb. 3,	3.25	3.25	–	4.	–	30.6	14.5	9.9	24.4	14.86	1:7.47	952
Feb. 3 to 10,	3.25	3.25	–	–	–	39.1	13.4	9.9	23.3	12.82	1:7.26	905
16 to 22,	3.25	–	–	–	–	55.	11.6	7.7	19.3	12.85		895
22 to Mar. 1.	3.25	–	–	–	–	49.*	11.3	8.6	19.9	11.12	1:7.	855
Mar. 1 to 8,	3.25	–	–	–	–	46.6	11.	8 1	19.1	10.72		876
13 to 19,	–	3.25	–	–	–	36.6	12.	9.1	21.1	9 02	1:8.7	893
24 to 30,	–	3.25	–	20.	–	–	11.1	7.9	19.	20.75	1:9.75	892
31 to Apr. 6,	3.25	–	–	20.	–	–	10.9	7.7	18 6	20 77	1:8.28	935
Apr. 12 to 18,	3.25	3.25	–	20.	–	–	12.4	9.7	22.1	23.63	1:8.11	897

* Commenced feeding ensilage of uncut corn, Feb. 23.

Analyses of Milk.

	Water.	Solids.	Fat (in solids).	Solids not fat.
Nov. 18,	86.02	13.98	4.98	9.00
24,	87.15	12.85	3.65	9.20
Dec. 5,	85.12	14.88	5.10	9.78
10,	87.20	12.80	3 74	9.06
17,	87.26	12.74	3.86	8.88
23,	86 22	13.78	4.70	9.08
Jan. 7,	87.41	12.59	3.64	8.95
15,	87.05	12.95	3.95	9.00
21,	86.54	13.46	3.97	9.49
Feb. 3,	86.28	13.72	4.53	9.19
10,	86.95	13.05	3.30	9.75
March 5,	86.52	13.48	4.90	8 58
16,	85.20	14.80	3.66	10.42
30,	86.36	13.64	4.51	9.13
April 6,	87.53	12.47	3.58	8 89
13,	86.25	13.75	4 51	9.24

II. Record of Bessie.

Feeding Periods.	Feed Consumed (lbs.) per day.						Milk Produced (lbs.) per day.			Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Nutritive Ratio.	Weight of Animal.
	Wheat Shorts.	Corn Meal.	Gluten Meal.	Hay.	Corn Fodder.	Corn Ensilage (cut).	Morning.	Evening.	Total.			
Nov. 1 to 10,	3.25	3.25	–	19.6	–	–	17.4	14.4	31 8	23.27	1:8.1	810
11 to 17,	3.25	3.25	–	20.	–	–	16.1	12.9	29.0	23 63		805
18 to 24,	3.25	3.25	–	15.	–	–	14.3	11 6	25.9	19.16	1:7.76	786
25 to Dec. 1,	3.25	3.25	–	15 6	–	–	14.9	10.	24.9	19.69		790
Dec. 4 to 13,	3.25	3.25	3.25	14.6	–	–	16.	12.7	28.7	21.22	1:6.1	817
13 to 23,	3.25	3.25	3.25	7.4	7.3	–	15.4	11.9	27.3	22.02	1:5.68	828
24 to Jan. 2,	3.25	3.25	–	7.7	7.7	–	14.8	10.5	25.3	19 80		855
Jan. 2 to 12,	3.25	3.25	–	8.5	8.4	–	14.3	10.	24.3	21.15	1:6.84	866
13 to 22,	3.25	3.25	–	8.	8.	–	13.8	9.1	22.9	20.34		867
27 to Feb. 3,	3.25	3.25	–	4.	–	36.3	13.7	9.1	22.8	15.90	1:7.64	821
Feb. 4 to 10,	3.25	3 25	–	–	–	39.	13.	9.	22.	12.81	1:7.26	792
16 to 22,	3.25	–	–	–	–	54.3	11.7	7.	18.7	12.72		775
23 to Mar. 1,	3 25	–	–	–	–	50.*	10.4	7.	17.4	11.29	1:6.92	790
Mar. 2 to 8,	3.25	–	–	–	–	40.	9.1	7.	16.1	9.61		755
13 to 19,	–	3.25	–	–	–	34.3	8 3	7.	15.3	8.63	1:8.67	730
24 to 30,	–	3.25	–	16.3	–	–	9.	7.1	16.1	17.44	1:9.62	750
31 to Apr. 6,	3.25	–	–	14.6	–	–	9.1	7.	16.	15.94	1:7.78	782
Apr. 12 to 18,	3.25	3.25	–	16.	–	–	11.6	9.3	20.9	20.85	1:7.81	782

* Commenced feeding ensilage of uncut corn, Feb. 23.

Analyses of Milk.

	Water.	Soldis.	Fat (in solids).	Solids not fat.
Nov. 17,	87.00	13.00	4.04	8.96
24,	86.91	13.09	3.86	9 23
Dec. 5,	86.18	13.82	4.02	9.80
10,	86.99	13.01	3.72	9.29
17,	87.41	12.59	3.32	9.27
23,	85.36	14.64	4.75	9.89
Jan. 7,	87.26	12.74	3.76	8.98
15,	87.29	12.71	3.91	8.80
21,	87.89	12.11	3 02	9.09
Feb. 2,	86.92	13.08	4.90	8.18
10,	86.54	13.46	4.11	9.35
March 5,	85.53	14.47	4.74	9.73
16,	87.19	12.81	3.86	8 95
30,	87.15	12.85	3.54	9.31
April 2,	86.81	13.19	4.49	8.70
13,	87 35	12.65	3.74	8.91

Cost of Feed per Quart of Milk.

(LADY HORACE.)

FEEDING PERIODS.	Total Quantity of Milk Produced during Entire Period.	Average Daily Yield of Milk for Period.	Total Amount of Shorts Consumed during Period.	Total Amount of Corn Meal Consumed during Period.	Total Amount of Hay Consumed during Period.	Total Amount of Dry Corn Fodder Consumed during Period.	Total Amount of Ensilage Consumed during Period.	Total Amount of Gluten Meal Consumed during Period.	Total Cost of Fodder Consumed during Period.	Average Cost of Feed for Production of One Quart of Milk for Period.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Cents.*
Nov. 1-10, . .	350.0	35.0	32.5	32.50	200.0	–	–	–	$2 25	1.29
11-17, . .	217.7	31.1	22.75	22.75	140.0	–	–	–	1 57	1.44
18-24, . .	203.3	28.9	22.75	22.75	121.8	–	–	–	1 44	1.42
25-Dec. 1, .	214.2	30.6	22.75	22.75	132.3	–	–	–	1 52	1.42
Dec. 4-13, . .	325.0	32.5	32.50	32.50	190.0	–	–	32.50	2 54	1.56
14-23, . .	296.0	29.6	32.50	32.50	83.0	83.0	–	32.50	1 95	1.32
23-Jan. 2, .	263.0	26.3	32.50	32.50	101.0	101.0	–	–	1 76	1.34
Jan. 3-12, . .	242.0	24.2	32.50	32.50	103.0	103 0	–	–	1 78	1.47
13-22, . .	241 0	24.1	33.50	32.50	107.0	107.0	–	–	1 82	1.51
27-Feb. 3, .	195.2	24.4	26.00	26.00	32.0	–	244.8	–	1 18	1.21
Feb. 4-10, . .	163.1	23.3	22.75	22.75	–	–	273.7	–	90	1.11
16-22, . .	135.1	19.3	22.75	–	–	–	385.0	–	79	1.17
23-Mar. 1, .	139.3	19.9	22.75	–	–	–	343.0	–	73	1.05
Mar. 2- 8, . .	133.7	19.1	22.75	–	–	–	326.2	–	71	1.06
13-19, . .	147.7	21.1	–	22.75	–	–	256.2	–	61	0.83
24-30, . .	133.0	19.0	–	22.75	140.0	–	–	–	1 31	1.97
31-Apr. 6, .	130.2	18.6	22.75	–	140.0	–	–	–	1 31	2.01
Apr. 12-18, . .	154.7	22.1	22.75	25.75	140.0	–	–	–	1 57	2.03

Cost of Feed per Quart of Milk.

(BESSIE.)

FEEDING PERIODS.	Total Quantity of Milk Produced during Entire Period.	Average Daily Yield of Milk for Period.	Total Amount of Shorts Consumed during Period.	Total Amount of Corn Meal Consumed during Period.	Total Amount of Hay Consumed during Period.	Total Amount of Dry Corn Fodder Consumed during Period.	Total Amount of Ensilage Consumed during Period.	Total Amount of Gluten Meal Consumed during Period.	Total Cost of Fodder for Period.	Average Cost of Feed for the Production of One Quart of Milk for Period.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Cents.*
Nov. 1-10, . .	318.0	31.8	32.50	32.50	196.0	–	–	–	$2 22	1.39
11-17, . .	203.0	29.0	22.75	22.75	140 0	–	–	–	1 57	1.55
18-24, . .	168.0	24.0	22.75	22.75	105.0	–	–	–	1 31	1.56
25-Dec. 1, .	181.3	25.9	22.75	22 75	109.2	–	–	–	1 34	1.48
Dec. 4-13, . .	287.0	28.7	32.50	32.50	146.0	–	–	32.50	2 21	1.55
14-23, . .	273.0	27.3	32.50	32.50	74.0	73.0	–	32.50	1 85	1.36
24-Jan. 2, .	253.0	25.3	32.50	32.50	77.0	77.0	–	–	1 52	1.20
Jan. 3-12, . .	243.0	24.3	32 50	32.50	85.0	84 0	–	–	1 60	1.32
13-22, . .	229.0	22.9	32.50	32.50	80.0	80.0	–	–	1 55	1.35
27-Feb. 3, .	182.4	22.8	26.00	26 00	32.0	–	290.4	–	1 24	1.36
Feb. 4-10, . .	154.0	22.0	22.75	22.75	–	–	273.0	–	90	1.17
16-22, . .	130.9	18.7	22.75	–	–	–	380.1	–	79	1 21
28-Mar. 1, .	121.8	17.4	22.75	–	–	–	350.0	–	74	1.22
Mar. 2- 8, . .	112.7	16.1	22.75	–	–	–	280.0	–	65	1.16
13-16, . .	107.1	15.3	–	22.75	–	–	240.1	–	59	1.10
24-30, . .	112.7	16.1	–	22.75	114.1	–	–	–	1 12	1.99
31-Apr. 6, .	112.0	16.0	22.75	–	102.2	–	–	–	1 03	1.84
Apr. 12-18, . .	146.3	20.9	22.75	22.75	112.0	–	–	–	1 36	1.86

Special Analyses of Milk.

Regarding the quantity and quality of nitrogenous constituents of samples of milk collected before, during and after feeding corn ensilage.

Lady Horace.

	January 21.	February 10.	March 5.
Specific Gravity,	1.0346 at 18° C.	1.0341 at 13° C.	1.032 at 13° C.
Solids,	13.46 per cent.	13.05 per cent.	13.48 per cent.
Fat (in solids),	3.97 "	3.30 "	4.90 "
Solids not Fat,	9.49 "	9.75 "	8.58 "
Ash,	0.80 "	– –	0.80 "
Nitrogen in Casein,	0.43 "	0.29 "	0.31 "
" " Albumin,	0.04 "	0.06 "	0.04 "
" Lacto-Protein,*	0.05 "	0.11 "	0.06 "
Total Nitrogen,	0.52 "	0.46 "	0.41 "

* Collective name for nitrogenous constituents not casein or albumin.

Bessie.

	January 21.	February 10.	March 5.
Specific Gravity,	1.0338 at 16° C.	1.0338 at 16° C.	1.035 at 14.5° C.
Solids,	12.12 per cent.	13.49 per cent.	14.47 per cent.
Fat (in solids),	3.02 "	3.72 "	4.74 "
Solids not Fat,	9.10 "	9.77 "	9.73 "
Ash,	0.76 "	– –	0.68 "
Nitrogen in Casein,	0.40 "	0.30 "	0.43 "
" " Albumin,	0.05 "	0.05 "	0.04 "
" Lacto-Protein,*	0.06 "	0.10 "	0.07 "
Total nitrogen,	0.51 "	0.45 "	0.54 "

* Collective name for nitrogenous constituents not casein or albumin.

The results of these analyses are within the variations noticed in milk of recognized good quality.

Statement of the Composition of the Various Articles Fed During the Experiment.

HAY.

[From the Grounds of the Experiment Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.55	211.00	–	–	
Dry Matter,	89.45	1,789.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.69	93.80	–	–	
" Cellulose,	29.21	584.20	338.84	58	
" Fat,	2.65	53.00	24.38	46	
" Protein (Nitrogenous Matter),	9.02	180.40	102.83	57	1 : 10.6
Non-nitrogenous Extract Matter,	54.43	1,088.60	684.42	63	
	100.00	2,000.00	1,150.87	–	

The grass was cut the 20th of June, 1884, when in the last stage of blooming. It is of a fair composition.

SHREDDED CORN FODDER.

[From the Experimental Plats of the Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.95	139.00	–	–	
Dry Matter,	93.05	1,861.00	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude Ash,	5.16	103.20	–	–	
" Cellulose,	33.46	669.20	481 82	72	
" Fat,	1.71	34.20	25.65	75	
" Protein (Nitrogenous Matter),	12.15	243.00	163 39	73	1 :7.23
Non-Nitrogenous Extract Matter,	47.52	950.40	636.77	67	
	100.00	2,000.00	1,307.63		

The corn was cut September 1, 1885, when the kernels were in the milk. The green fodder contained 21.9 per cent. of dry vegetable matter, and had the appearance of a somewhat prematurely ripened crop, — a circumstance confirmed by the results of the analysis, which shows a smaller amount of saccharine and starchy constituents than commonly noticed in this variety of corn (Clark) at the stated stage of growth.

ENSILAGE OF CUT CORN.

[From corn raised upon Plats of the Experiment Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	81.88	1,637.60	–	–	
Dry Matter,	18.12	362.40	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude Ash,	5.07	101.40	–	–	1 : 11.8
" Cellulose,	26.23	524.60	377.71	72	
" Fat,	3.49	69.80	52.35	75	
" Protein (Nitrogenous Matter),	7.83	156.60	114.32	73	
Non-Nitrogenous Extract Matter,	57.38	1,147.60	768.89	67	
	100.00	2,000.00	1,313 27		

The filling of the silo was carried on during the first and second days of September, 1884; the mass was covered over with boards without weights until the temperature in the mass ceased to increase. In a few places, about eighteen inches below the surface of the mass, the temperature rose to 122° F. or 50° C.; whilst taking the entire silo into consideration, 116° F., or 47° C., represents fairly the highest average temperature attained in our case. The mass showed a slight acid reaction on the second day after cutting the corn, and before putting on the final weight (sixty pounds of sand per square foot, in barrels, as in the preceding year).

The silo was opened for the use of its contents on the 20th of January, 1885. The ensilage was covered with a mouldy mass, several inches in thickness. This being removed, the remainder proved — although acid to customary reagents — a fair article of its kind, and a decided improvement on the ensilage of the first trial. This result is largely due to the fact of using corn of a more matured stage of growth.

For the details of the production of the ensilage, I refer to the Second Annual Report of Experiment Station (1884); or Report of the Secretary of the State Board of Agriculture for 1884.

WHOLE-CORN ENSILAGE.

[From corn raised upon the Plats of the Experiment Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.18	1,663.60	–	–	
Dry Matter,	16.82	336.40	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude Ash,	4.23	84.60			
" Cellulose,	29.44	588.80	423.84	72	1 : 9.71
" Fat,	3.69	73.80	55.35	75	
" Protein (Nitrogenous Matter),	9.03	180.60	131.84	73	
Non-Nitrogenous Extract Matter,	53.61	1,072 20	718.37	67	
	100.00	2,000.00	1,329.40		

The silo was filled with whole corn and covered at once, September 1, 1885, as described in detail in the last (Second) Annual Report of the Station; it was opened for feeding purposes on the 23d of February, 1885. The odor of the fresh ensilage resembled that of the pine apple (propionic ether), and turned, within twenty-four hours of exposure to the air, into that of vinegar; it had a slight

acid reaction when first exposed. The color was yellowish green, indicating a good state of preservation; the interior parts of the uncrushed stems showed the presence of saccharine constituents (glucose); and the kernels in the ear contained still an abudance of starch.

The ensilage obtained from whole plants — at once closed up — was in a better state of preservation than that which had been obtained from the same quality of corn previously cut into pieces of from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in length, and tested for the production of ensilage as described in the previous statement.

The mechanical condition of the whole corn ensilage is less satisfactory for feeding purposes, as far as an economical consumption of the same weight of both are concerned, than that produced from corn previously cut into pieces of from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in length.

CORN MEAL.

[Bought of John L. Holley, South Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40	–	–	
Dry Matter,	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.56	31.20	–	–	
" Cellulose,	2.66	53.20	18.09	34	1:8.76
" Fat,	4.27	85.40	64.90	76	
" Protein (Nitrogenous Matter),	11.43	228.60	194.31	85	
Non-nitrogenous Extract Matter,	80.08	1,601.60	1,505.50	94	
	100.00	2,000.00	1,782.80	–	

The article represents the average composition of the corn meal fed during the experiment with milch cows.

WHEAT BRAN.

81.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12 05	241.00	–	–	
Dry Matter,	87.95	1,759.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.64	132.80	–	–	
" Cellulose,	11.49	229.80	45.96	20	1 :3.77
" Fat,	4.75	95.00	76.00	80	
" Protein (Nitrogenous Matter),	17.86	357.20	314.34	88	
Non-nitrogenous Extract Matter,	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,384.46	–	

GLUTEN MEAL.

99.82 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.45	169.00	–	–	
Dry Matter,	91.55	1,831 00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	0.76	15.20	–	–	
" Cellulose,	1.73	34.60	11.76	34	1 :2.27
" Fat,	9.34	186.80	141.97	76	
" Protein (Nitrogenous Matter),	35.31	706.20	600.27	85	
Non-nitrogenous Extract Matter,	52.86	1,057.20	993.76	94	
	100.00	2,000.00	1,747.76	–	

Feeding Experiments with Pigs.

In the Second Annual Report, page 68–78 (Bulletin No. 13), has been described the first of a series of feeding experiments with pigs (May 21 to Sept. 22, 1884), which was planned for the purpose of studying the comparative feeding value of skim milk from the farm and of buttermilk from the Amherst creamery in connection with corn meal, for the production of pork. Equal measures of skim milk and of creamery buttermilk had been fed, with an addition of a corresponding weight of corn meal, in each case. Three ounces of corn meal for every quart of each kind of milk consumed formed the basis for the compounding of the entire diet of the (six) animals on trial. The daily amount of feed required was regulated by the appetite of each animal.

A summary of the results obtained in that connection showed that,—taking corn meal, pound for pound, and skim milk and creamery buttermilk, quart for quart,—practically the same quantity of dressed pork had been obtained in both cases, when stating the final weight of each lot of animals—three in number—in one sum; 510 pounds where skim milk and meal had been fed, and 514 pounds in the case of buttermilk and meal. Counting in each case the particular feed (milk and meal) with regard to the amount of dry organic matter which it contained, it was noticed that the buttermilk feed had proved—taking pound for pound of dry matter of the mixture—the most nutritious article; for 24 pounds of dry organic matter contained in the buttermilk and corn meal feed, had produced, as mean results, one pound of dressed pork; whilst in the case of skim milk and meal, 29 pounds of dry organic matter had been spent in the production of one pound.

The lot of animals fed with creamery buttermilk and corn meal had also returned a larger profit, even at the rates of the cost of each constituent of the diet ruling during the period of feeding,—May to September, 1884. These results were in so far of special interest as the skim milk from the farm was the more concentrated and richer article of the two kinds of milk fed, according to special chemical analyses made at various times. The skim milk had contained more

than 20 per cent. more dry organic matter than the creamery buttermilk. This circumstance seemed to indicate a waste of skim milk, as compared with the results obtained in case of the former. As the skim milk was the most costly article of the feed, a waste of that article cannot otherwise but seriously affect the cost of the dressed pork obtained by its use.

In our first experiment—1884—the corn meal was charged $28 per ton at the mill; creamery buttermilk, $1.37 cents per gallon, the contractor's price; and farm skim milk, two cents asked for at the farm. Cost of feed per pound of dressed pork at these rates amounted, in case of the creamery milk feed, to 4.6 cents; and in case of the farm skim milk feed, to 5.8 cents per pound.

As a charge of two cents per gallon for skim milk may be considered somewhat arbitrary, its commercial value for feeding purposes has been based, with more propriety, in our subsequent experiments, on the amount of solid matter it contains as compared with that of the creamery buttermilk, taking the contractor's price of the latter as the standard.

	Percentage of Solids.		Cost per Gallon.	
	1884.	1885.	1884.	1885.
Creamery buttermilk, . . .	7.09	8.00	1.37 cts.	1.37 cts.
Farm skim milk, ...	9.58	10.22	1.78 cts.	1.75 cts.

A recalculation of the cost of feed consumed in our first experiment (1884) at the rate adopted in our second experiment (1885), described within these pages, does not alter the financial results of that experiment, so far as the relative cost of each kind of feed is concerned.

Cost of Feed per Pound of Dressed Pork.

	1884.	1885.
Creamery buttermilk and meal, . . .	4.6 cts.	4.20 cts.
Farm skim milk and meal, ...	5.8 cts.	4.85 cts.

The previous short discussion of the first feeding experiment seemed to be necessary in the interest of a desirable understanding of the subsequent description of the second feeding experiment, beginning Nov. 5, 1884, and ending March 17, 1885.

Second Feeding Experiment.—Twelve pigs served in this trial, all of which were barrows. Six of them were crosses of Berkshire sow with Yorkshire boar; their individual weights varied from 38 to 46 lbs. The remaining six animals were crosses of Chester White sow with Yorkshire boar, weighing from 15 to 19 lbs. each. They were arranged for the experiment in two lots,— A and B,— each containing three of the former and three of the latter breed. The first three numbers in each lot are the heavier animals (Berkshires).

Lot A (1, 2, 3, 4, 5 and 6) was fed with creamery buttermilk and corn meal, at the rate of three ounces of corn meal for every quart of milk consumed, until the quantity of milk required per day to meet the individual want of each animal amounted to from twelve to thirteen quarts, when the increase of milk for the daily diet ceased.

The subsequent still steadily increasing demand for more feed was supplied by a gradual increase of corn meal, rising from three to four, five, six, and finally to seven and one-half ounces of meal for every quart of buttermilk. The experiment terminated with ninety-two ounces of corn meal to twelve quarts of milk.

Lot B (7, 8, 9, 10, 11 and 12) was fed with skim milk from the farm, and corn meal, at the following rates: —

Nos. 7, 8 and 9 (Berkshire) received, from the 5th of of November to the 9th of December, two ounces of meal for every quart of skim milk consumed; from the 9th of December to the 15th of January, four ounces of meal to every quart of milk. The meal was subsequently gradually raised to eight ounces per quart of milk. The consumption of milk had reached ten quarts per day, when the want of skim milk necessitated (February 7) a change in the course of feeding adopted for this lot of pigs. Creamery buttermilk and meal — six ounces of meal for every quart of the latter — were substituted; at that period seventy-two

ounces of meal and twelve quarts of milk were fed. The experiment was continued, in the same manner as Nos. 1, 2 and 3 of Lot A, until the 17th of March.

The second half of Lot B (Nos. 10, 11 and 12) received, from November 5 to December 9, two ounces of meal for every quart of skim milk consumed; from the 9th of December to the 14th of January, four ounces; from the 14th of January to the 17th of February, from five to five and one-half ounces of meal per quart. At this stage of the experiment, when the daily consumption of the milk had reached from six to seven quarts, the increase of milk ceased. The call for additional feed during the remainder of the experiment was supplied by a gradual increase of meal, until March 25, when the animals were killed. The daily consumption of meal had reached, one week before the close of the experiment, one hundred and eight ounces, or $6\frac{3}{4}$ lbs., in case of every animal of this division of Lot B, which proved to be the most profitable one of the entire experiment.

The tabular statement which follows aims at a more concise presentation of numerical relations regarding important points of the entire experiment, as far as every individual animal as well as each lot is concerned. A summary of results, which closes the detailed statements, shows that Lot B, on the whole, has given the best returns, with the second division leading. The superior quality of the skim milk (Lot B) is rendered quite conspicuous by a saving of three hundred and sixty gallons of milk, and an increased production of one hundred and one pounds of dressed pork, as compared with the use of creamery buttermilk (Lot B), with practically a corresponding quantity of meal, under otherwise corresponding conditions.

The results of our first experiment were reversed, as might have been expected, by a more judicious distribution of an increased proportion of meal at the various stages of growth. The cost of the entire feed consumed by Lot A amounted to $51.00, and that of Lot B to $53.02; whilst the cost of feed for the production of one pound of dressed pork in Lot A amounted to 5.73 cents, and that of Lot B amounted to 5.37

cents. The influence of a severe winter, and thus gradually a lower temperature, during the second experiment (November to March) has no doubt exerted a depressing influence on the total results, when compared with the results of the first experiment (May to September).

Number of Pounds of Dry Matter in Feed required to produce One Pound of Dressed Pork.

	I., 1884. Summer.	II., 1885. Winter.
Creamery buttermilk feed, ...	2.4 lbs.	3.67 lbs.
Skim milk feed, ...	2.9 "	3.33 "

Aside from the stated facts, there are some other points of a more general character deserving of mention in this connection, which are not infrequently underestimated in the feeding of pigs for the market.

First. A careful preparation of the feed for young pigs, with reference to a higher nutritious character at the beginning, and to a gradually increasing bulk for the proper distention of the digestive organs, to make them hereafter good eaters. A liberal supply of milk, with a gradual increase of meal, beginning with from one to two ounces of meal per quart, has served us well.

Second. A timely closing up of the fattening process in the interest of profits for the best returns of the feed are obtained in the earlier periods of growth; in our case, as a rule, profits were doubtful after the animal reached a weight of from 180 to 200 lbs. There may be exceptions to this observation when the cost of feed is low, and the market price of dressed pork very high, — a circumstance not often happening. Our dressed pork was sold at $6\frac{3}{4}$ cents per pound.

A good illustration in this direction may be furnished by a detailed record of actual results in the case of pigs Nos. 10, 11 and 12, of Lot B (pigs fed with skim milk and meal).

	Live Weight of Animal at the close of Feeding Period (in pounds).	Gain in Live Weight during Period (in pounds).	One Hundred Pounds of Dry Matter in Feed had produced Live Weight (in pounds).	Cost of Feed for Production of one Pound of Live Weight (in cents).
No. 10. I. Feeding Period, . .	48.5	30.0	82.0	2.13
II. " " . .	98.5	50.0	55.1	2.98
III. " " . .	152.0	53.5	39.1	4.90
IV. " " . .	209.0	57.0	23.8	6.12
No. 11. I. Feeding Period, . .	45.5	28.5	77.9	2.25
II. " " . .	89.5	44.0	48.5	3.38
III. " " . .	138.0	48.5	35.4	4.52
IV. " " . .	191.0	53.0	22.1	6.60
No. 12. I. Feeding Period, . .	48.0	30.0	82.0	2.13
II. " " . .	97 5	49.5	54.5	3.01
III. " " . .	147.5	50.0	36.4	4.38
IV. " " . .	216.0	68.5	28.6	5.10

As the difference of live weight and dressed weight in the case here under discussion amounts on an average to 18¾ lbs. per hundred weight, and as we sold our dressed pork at 6¾ cents per pound, we lost money on the feed whenever its cost exceeded 5.49 cts. per pound of live weight gained; in other words, in only one case, that of No. 12, did we make money during the IV. feeding period of our trial by converting the feed into live weight. These relations appear most striking in feeding periods of equal length, and of about four weeks' duration. Our younger animals showed, in every case, a larger gain in live weight during the first period of feeding than the heavier ones, showing the advantage of beginning well at an early stage of growth.

[A.]

BUTTERMILK AND CORN MEAL

No. 1.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Quantity of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and **1885.**								lb. oz.
Nov. 5 to Jan. 27.	156.8	796 0	137.0	137.1	1:3.5	43.5	144.5	1 4
Jan. 27 to Feb. 3, .	28.0	86.5	24.5	14.9	1:4.	144.5	171.5	3 14
Feb. 3 to Feb. 27, .	118.8	288.0	97.7	49.7	1:4.4	171.5	205.5	1 7
Feb. 27 to March 17, .	102.4	216.0	89.5	37.3	1:4.8	205.5	231.0	1 7

Total amount of feed consumed from Nov. 5, 1884, to March 17, 1885, —

399 lbs. Corn Meal, equal to dry matter, ...	349	lbs.
1,386 quarts Buttermilk, equal to dry matter, ...	239	lbs.
Total amount of dry matter, ...	588	lbs.

Live weight of animal at beginning of experiment, . .	43.5	lbs.
Live weight at time of killing, ...	231.0	lbs.
Live weight gained during experiment, ...	188.5	lbs.
Dressed weight at time of killing, ...	195.0	lbs.
Loss in weight by dressing, 36 lbs., or 16 per cent.		
Dressed weight gained during experiment, ...	159.0	lbs.

Cost of feed consumed during the experiment, —

399 lbs. Corn Meal at $22.50 per ton, ...	$4 49
346 gals. Buttermilk at 1.37 cents per gallon, ...	4 75
	$9 24

3.13 lbs. of dry matter fed yielded one pound of live weight, and 3.69 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.81 cts.

[A.]

BUTTERMILK AND CORN MEAL.

No. 2.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per Day during Period.
1884 and **1885.**								lb. oz.
Nov. 5 to Jan. 27, .	156.8	796.0	137.0	137.1	1:3 5	46.0	156.5	1 5
Jan. 27 to Feb. 3, . .	28.0	86.5	24.5	14.9	1:4.	156.5	171.0	2 1
Feb. 3 to Feb. 27, . .	111.8	288.0	97.7	49.7	1:4 4	171.0	220.0	2 1
Feb. 27 to March 17, .	102.4	216.0	89.5	37.3	1:4.8	220.0	247.0	1 8

Total amount of feed consumed from Nov. 5, 1884, to March 17, 1885, —

399 lbs. of Corn Meal, equal to dry matter, . . .	349.	lbs.
1,386 qts. Buttermilk, equal to dry matter, ...	239.	lbs.
Total amount of dry matter, ...	588.	lbs.
Live weight of animal at beginning of experiment, . .	46.	lbs.
Live weight at time of killing, ...	247.	lbs.
Live weight gained during experiment, ...	201.	lbs.
Dressed weight at time of killing, ...	204.	lbs.
Loss in weight by dressing, ...	43 lbs., or 17.5 per cent.	
Dressed weight gained during experiment, ...	168.	lbs.

Cost of feed consumed during experiment, —

399 lbs. Corn Meal at $22.50 per ton, ...	$4 49
346 gals. Buttermilk at 1.37 cents per gal., ...	4 75
	$9 24

2.93 lbs. of dry matter fed yielded one pound of live weight; and 3.54 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.56 cents.

[A.]

BUTTERMILK AND CORN MEAL.

No. 3.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and **1885.**								lb. oz.
Nov. 5 to Jan. 27, ..	156.8	796.0	137.0	137.1	1:3.5	38.	150.0	1 6
Jan. 27 to Feb. 3, .	28.0	86.5	24.5	14.9	1:4.	150.	153 0	0 7
Feb. 3 to Feb. 27, .	111.8	288 0	97.7	49.7	1:4.4	153.	198.0	1 14
Feb. 27 to March 17, .	102.4	216.0	89.5	37.3	1:4.8	198.	218.5	1 2

Total amount of feed consumed from Nov. 5, 1884, to March 17, 1885, —

399 lbs. Corn Meal, equal to dry matter, ...	349. lbs.
1,386 qts. Buttermilk, equal to dry matter, ...	239. lbs.
Total amount of dry matter, ...	588. lbs.

Live weight of animal at beginning of experiment, . .	38.0 lbs.
Live weight at time of killing, ...	218.5 lbs.
Live weight gained during experiment, ...	180.5 lbs.
Dressed weight at time of killing, ...	183.0 lbs.
Loss in weight by dressing, ...	35.5 lbs., or 16.13 per cent.
Dressed weight gained during experiment, . . .	151.0 lbs.

Cost of feed consumed during experiment, —

399 lbs. of Corn Meal at $22.50 per ton, ...	$4 49
346 gals. Buttermilk at 1.37 cents per gal., ...	4 75
	$9 24

3.25 lbs. of dry matter fed yielded one pound of live weight, and 3.9 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of one pound of dressed pork, 6.1 cents.

[A.]

BUTTERMILK AND CORN MEAL.

No. 4.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Jan. 27, .	96	490	84.0	84.5	1 : 3.5	19.0	101.0	1 0
Jan. 27 to Feb. 25, .	101	321	88.0	55.3	1 : 4	101.0	135.5	1 5
Feb. 25 to Mar. 17, .	88	228	76.7	39.3	1 : 4.4	135.5	161.5	1 5
Mar. 17 to Mar. 26, .	53	108	46.2	18.6	1 : 4.8	161.5	165.0	0 6

Total amount of feed consumed from Nov. 1, 1884, to March 26, 1885, —

338 lbs. Corn Meal, equal to dry matter, ...	295.0 lbs.
1,147 qts. Buttermilk, equal to dry matter, ...	197.7 lbs.
Total amount of dry matter, ...	492.7 lbs.

Live weight of animal at beginning of experiment, . .	19 lbs.
Live weight at time of killing, ...	165 lbs.
Live weight gained during experiment, ...	146 lbs.
Dressed weight at time of killing, ...	133 lbs.
Loss in weight by dressing, ...	32 lbs., or 19.5 per cent.
Dressed weight gained during experiment, ...	118 lbs.

Cost of feed consumed during the experiment, —

338 lbs. Corn Meal at $22.50 per ton, ...	$3 80
287 gals. Buttermilk at 1.37 cents per gal., ...	3 93
	$7 73

3.37 lbs. of dry matter fed, yielded 1 lb. of live weight, and 4.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.55 cents.

[A.]

BUTTERMILK AND CORN MEAL.

No. 5.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Jan. 27, .	96	490	84.0	84.5	1:3.5	19	102	1 0
Jan. 27 to Feb. 25, .	101	321	88.0	55.3	1:4.	102	148	1 9
Feb. 25 to Mar. 17, .	88	228	76 6	39.3	1:4.4	148	188	2 0
Mar. 17 to Mar. 26, .	53	408	46 2	18.6	1:4.8	188	198	1 2

Total amount of feed consumed from Nov. 5, 1884, to March 26, 1886, —

338 lbs. Corn Meal, equal to dry matter, ...	295 lbs.
1,147 qts. Buttermilk, equal to dry matter, ...	197.7 lbs.
Total amount of dry matter, ...	492.7 lbs.

Live weight of animal at beginning of experiment, . .	19.0 lbs.
Live weight at time of killing, ...	198.0 lbs.
Live weight gained during experiment, ...	179 0 lbs.
Dressed weight at time of killing, ...	161.5 lbs.
Loss in weight by dressing, ...	36.5 lbs., or 18.4 per cent.
Dressed weight gained during experiment, ...	146.0 lbs.

Cost of feed consumed during the experiment, —

338 lbs. Corn Meal, at $22.50 per ton, ...	$3 80
287 gals. Buttermilk, at 1.37 cents per gal., . . .	3 93
	$7 73

2.75 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.4 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.29 cents.

[A]

BUTTERMILK AND CORN MEAL.

No. 6.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Jan. 27, .	96	490	84 0	84.5	1 : 3.5	15.0	107.5	1 2
Jan. 27 to Feb. 25, .	101	321	88.0	55.3	1 : 4.	107.5	155.0	1 10
Feb. 25 to Mar. 17, .	88	228	76.7	39.3	1 : 4.4	155.0	191.0	1 13
Mar. 17 to Mar. 26, .	53	108	46.2	18.6	1 : 4.8	191.0	198.5	0 13

Total amount of feed consumed from Nov. 5, 1884, to March 26, 1885,—

338 lbs. Corn Meal, equal to dry matter, ... 295 0 lbs.
1,147 qts. Buttermilk, equal to dry matter, ... 197.7 lbs.

Total amount of dry matter, ... 492.7 lbs.

Live weight of animal at beginning of experiment, . . 15.0 lbs.
Live weight at time of killing, ... 198.5 lbs.
Live weight gained during experiment, ... 183 5 lbs.
Dressed weight at time of killing, ... 159.5 lbs.
Loss in weight by dressing, ... 39 lbs., or 19.6 per cent.
Dressed weight gained during experiment, ... 147.5 lbs.

Cost of feed consumed during experiment,—

338 lbs. Corn Meal, at $22.50 per ton, ... $3 80
287 gals. Buttermilk, at 1.37 cents per gal., ... 3 93

$7 73

2.68 lbs. of dry matter fed yielded 1 lb. of live weight; and 3.34 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.24 cents.

[B.]

SKIM MILK AND CORN MEAL.

No. 7.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and **1885.**								lb. oz.
Nov. 5 to Dec. 9, . .	24.5	197	21 5	44.7	1 : 2.7	37	69	0 15
Dec. 9 to Jan. 27, . .	121.0	452	105.4	102.6	1 : 4	69	160	1 14
Jan. 27 to Feb. 3, . .	28.0	70	24 5	15.8	1 : 3.9	160	171	1 9
Feb 3 to Feb. 7, . .	19.0	36	16 4	8.1	1 : 4 3	171	179	2 0
Feb. 7 to Mar. 17, .	196.0	456*	171.4	78.7	1 : 4 7	179	254	2 0

* Buttermilk

Total amount of feed consumed from Nov. 5, 1884, to March 17, 1885,—

338.5 lbs. Corn Meal, equal to dry matter, ...	339.2 lbs.
755 qts. Skim Milk, equal to dry matter, ...	171.2 lbs.
456 qts. Buttermilk, equal to dry matter, ...	78.7 lbs.
Total amount of dry matter, ...	589.1 lbs.

Live weight of animal at beginning of experiment, . .	37.0 lbs.
Live weight at time of killing, ...	254.0 lbs.
Live weight gained during experiment, ...	207.0 lbs.
Dressed weight at time of killing, ...	208.5 lbs.
Loss in weight by dressing, ...	45 5 lbs., or 17 8 per cent.
Dressed weight gained during experiment, ...	178.0 lbs.

Cost of feed during experiment, —

388.5 lbs. Corn Meal, at $22.50 per ton, ...	$4 37
189 gals. Skim Milk, at 1.8 cents per gal., ...	3 40
114 gals. Buttermilk, at 1.37 cents per gal., ...	1 56
	$9 33

2.71 lbs. of dry matter fed yielded 1 lb. of live weight; and 3.31 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.24 cents.

[B.]

SKIM MILK AND CORN MEAL.

No. 8.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry-Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Dec. 9, . .	24 5	197.0	21.5	44.7	1:2.7	41.5	74.0	0 15
Dec. 9 to Jan. 27, . .	121.0	452.0	105.4	102.6	1:4	74.0	152.5	1 9
Jan. 27 to Feb. 3, . .	28.0	70.0	24.5	15.8	1:3.9	152.5	176.0	3 6
Feb. 3 to Feb. 7, . .	19.0	36.0	16.4	8.1	1:4.3	176.0	178.0	0 8
Feb. 7 to March 17, .	196.0	456.0*	171.4	78.7	1:4.7	178 0	243.0	1 11

* Buttermilk.

Total amount of feed consumed from Nov. 5, 1884, to March 17, 1885,—

388.5 lbs. Corn Meal, equal to dry matter,	. . . .	339.2 lbs.
755 qts. Skim Milk, equal to dry matter,	. . . .	171.2 lbs.
456 qts. Buttermilk, equal to dry matter,	. . . .	78.7 lbs.
Total amount of dry matter,	. . . . .	589.1 lbs.

Live weight of animal at beginning of experiment,	. . 41.5 lbs.
Live weight at time of killing,	. . . . . 243 0 lbs.
Live weight gained during experiment,	. . . . . 201.5 lbs.
Loss in weight by dressing,	. . . . 38 lbs., or 15.6 per cent.
Dressed weight at time of killing,	. . . . . 205.0 lbs.
Dressed weight gained during experiment,	. . . . 170.0 lbs.

Cost of feed consumed during experiment,—

388.5 lbs. Corn Meal, at $22 50 per ton,	. . . . . $4 37
189 gals. Skim Milk, at 1.8 cts. per gal.,	. . . . . 3 40
114 gals. Buttermilk, at 1.37 cts. per gal.,	. . . . . 1 56
	$9 33

2.9 lbs. of dry matter fed, yielded 1 lb. of live weight; and 3.47 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.48 cts.

[B.]

SKIM MILK AND CORN MEAL.

No. 9.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry-Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Dec. 9, . .	24.5	197.0	21.5	44 7	1:2.7	40.0	77.0	1 1
Dec. 9 to Jan. 27, . .	121.0	452.0	105.4	102.6	1:4	77.0	160.5	1 11
Jan. 27 to Feb. 3, . .	28.0	70.0	24.5	15.8	1:3.9	160.5	171.0	1 8
Feb. 3 to Feb. 7, . .	19.0	36 0	16.4	8.1	1:4.3	171.0	179.5	2 2
Feb. 7 to March 17, .	196.0	456.0*	171.4	78.7	1:4.7	179.5	249.0	1 13

* Buttermilk.

Total amount of feed consumed from Nov. 5, 1884, to March 17, 1885,—

388.5 lbs. Corn Meal, equal to dry matter,	. . . .	339.2 lbs.
755 qts. Skim Milk, equal to dry matter,	. . . .	171.2 lbs.
456 qts. Buttermilk, equal to dry matter,	. . . .	78.7 lbs.
Total amount of dry matter,	. . . . .	589.1 lbs.

Live weight of animal at beginning of experiment,	. . 40.0 lbs.
Live weight at time of killing,	. . . . . 249 0 lbs.
Live weight gained during experiment,	. . . . . 209.0 lbs.
Dressed weight at time of killing,	. . . . . 209.0 lbs.
Loss in weight by dressing,	. . . . 40 lbs., or 16 per cent.
Dressed weight gained during experiment,	. . . . 174.5 lbs.

Cost of feed consumed during experiment, —

385.5 lbs. Corn Meal, at $22.50 per ton,	. . . . .	$4 37
189 gals. Skim Milk, at 1.8 cts. per gal.,	. . . . .	3 40
114 gals. Buttermilk, at 1.37 cts. per gal.,	. . . . .	1 56
		$9 33

2.81 lbs. of dry matter fed, yielded 1 lb. of live weight; and 3.37 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.35.

[B.]

SKIM MILK AND CORN MEAL.

No. 10.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry-Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Dec. 9, . .	13.5	109	11.9	24.7	1:2.7	18.5	48.5	0 14
Dec. 9 to Jan. 15, . .	51.0	204	44.5	46.3	1:3.1	48.5	98 5	1 6
Jan. 15 to Feb. 17, .	88.0	266	76 6	60 3	1:3.9	98.5	152.0	1 10
Feb. 17 to March 25, .	209.0	252	182.5	57.2	1:5.	152.0	209.0	1 9

Total amount of feed consumed from Nov. 5, 1884, to March 25, 1885,—

361.5 lbs. Corn Meal, equal to dry matter, ...	315.5 lbs.
831.0 qts. Skim Milk, equal to dry matter, ...	188.5 lbs.
Total amount of dry matter, ...	504.0 lbs.
Live weight of animal at beginning of experiment, . .	18.5 lbs.
Live weight at time of killing, ...	209.0 lbs.
Live weight gained during experiment, ...	190.5 lbs.
Dressed weight at time of killing, ...	168 5 lbs.
Loss in weight by dressing, ...	40.5 lbs. or 19.4 per cent.
Dressed weight gained during experiment, ...	154.0 lbs.

Cost of feed consumed during experiment, —

361.5 lbs. Corn Meal, at $22.50 per ton, ...	$4 07
208 gals. Skim Milk, at 1.8 cts. per gal., ...	3 74
	$7 81

2.64 lbs. of dry matter fed yielded one pound of live weight; and 3.27 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5 07 cts.

[B.]

SKIM MILK AND CORN MEAL.

No. 11.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day, during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Dec. 9, . .	13.5	109	11 9	24.7	1:2.7	17.0	45.5	0 13
Dec. 9 to Jan. 15, . .	51.0	204	44.5	46.3	1:3.1	45.5	89.5	1 3
Jan. 15 to Feb. 17, .	88.0	266	76.6	60.3	1:3.9	89.5	138.0	1 7
Feb. 17 to March 25, .	209.0	252	182.5	27.2	1:5	138.0	191.0	1 8

Total amount of feed consumed from Nov. 5, 1884, to March 25, 1885,—

361.5 lbs. Corn Meal, equal to dry matter, ...	315.5 lbs.
831 qts. Skim Milk, equal to dry matter, ...	188.5 lbs.
Total amount of dry matter, ...	504.0 lbs.

Live weight of animal at beginning of experiment, . .	17.0 lbs.
Live weight at time of killing, ...	191.0 lbs.
Live weight gained during experiment, ...	174.0 lbs.
Dressed weight at time of killing, ...	158.5 lbs.
Loss in weight by dressing, ...	32.5 lbs., or 17 per cent.
Dressed weight gained during experiment, . . .	144.5 lbs.

Cost of feed consumed during experiment,—

361.5 lbs. Corn Meal, at $22.50 per ton, ...	$4 07
208 gals. Skim Milk, at 1.8 cts. per gallon, ...	3 74
	$7 81

2.89 lbs. of dry matter fed yielded one pound of live weight; and 3.48 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.4 cents.

[B.]

SKIM MILK AND CORN MEAL.

No. 12.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1884 and 1885.								lb. oz.
Nov. 5 to Dec. 9, . .	13.5	109	11.9	24.7	1 : 2.7	18.0	48 0	0 14
Dec. 9 to Jan. 15, . .	51.0	204	44.5	46.3	1 : 3.1	48.0	97.5	1 5
Jan. 15 to Feb. 17, .	88 0	266	76.6	60.3	1 : 3.9	97.5	147.5	1 8
Feb. 17 to Mar. 25, .	209.0	252	182.5	57.2	1 : 5.	147.5	216.0	1 14

Total amount of feed consumed from Nov. 5, 1884, to March 25, 1885, —

361.5 lbs. Corn Meal, equal to dry matter, ... 315.5 lbs.
831 qts. Skim Milk, equal to dry matter, ... 188.5 lbs.

Total amount of dry matter, ... 504.0 lbs.

Live weight of animal at beginning of experiment, . . 18 lbs.
Live weight at time of killing, ... 216 lbs.
Live weight gained during experiment, ... 198 lbs.
Dressed weight at time of killing, ... 173 lbs.
Loss in weight by dressing, ... 43 lbs., or 19.88 per cent.
Dressed weight gained during experiment, ... 169.5 lbs.

Cost of feed consumed during experiment, —

361.5 lbs. Corn Meal, at $22.50 per ton, ... $4 07
208 gals. Skim Milk, at 1.8 cents, ... 3 74

$7 81

2.55 lbs of dry matter fed yielded 1 lb. of live weight; and 2.97 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.61 cents.

Summary of Results of Experiments.

A. — Pigs Fed with Buttermilk and Corn Meal.

	Corn Meal (in pounds).	Buttermilk (in gallons).	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.	Cost per lb. of Dressed Pork (cents).
I., . . .	399.	346.	188.5	159.0	5.81
II., . . .	399.	346.	201.0	168.0	5.56
III., . .	399.	346.	180.5	151.0	6.10
IV., . .	338.	287.	146.0	118.0	6.55
V., . . .	338.	287.	179.0	146.0	5.29
VI., . .	338.	287.	183.5	147.5	5 24
	2,211.	1,899.	1,078.5	889.5	

B. — Pigs Fed with Skim Milk and Corn Meal.

	Corn Meal (in pounds).	Skim Milk (in gallons).	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.	Cost per lb. of Dressed Pork (cents).
VII., . .	388.5	303.	217.0	178 0	5.24
VIII., . .	388.5	303.	201.5	170.0	5.48
IX., . .	388.5	303.	209.0	174.5	5.35
X., . . .	361.5	208.	190.5	154.0	5.07
XI., . .	361.5	208.	174.0	144.5	5.40
XII., . .	361.5	208.	198.0	169 5	4.61
	2,250.	1,533.	1,190.0	990.5	

Total Cost of Feed Consumed during the Experiment.

A.	2,211 lbs. Corn Meal, ...	$24 98
	1,899 gals. Buttermilk, ...	26 02
		$51 00
B.	2,250 lbs. Corn Meal, ...	$25 42
	1,533 gals. Skim Milk, ...	27 60
		$53 02

Cost of Feed per Pound of Dressed Pork.

A.	Buttermilk and Meal, ...	5.73 cents.
B.	Skim Milk and Meal, ...	5.35 cents.

The pound of dressed pork sold at $6\frac{3}{4}$ cents.

The buttermilk contained 8 per cent. of solids; one quart of it weighed 34.5 ounces, and contained 2.76 ounces of dry matter; one gallon contained 11.04 ounces of solids. The skim milk contained 10.22 per cent. of solids; one quart of it weighed 35.5 ounces, and contained 3.63 ounces of solids; one gallon contained 14.52 ounces of dry organic matter.

Average of Analyses of Buttermilk from Nov 6, 1884, to Feb. 5, 1885.

[From Amherst Creamery.]

Water, ...	92.00	per cent.
Total solids, ...	8.00	"
	100.00	per cent.
Analysis of Solids:		
Fat, ...	0.20	per cent.
Protein (nitrogenous matter), ...	2.65	"
Ash, ...	0.60	"
Non-nitrogenous extract matter, ...	4.55	"
	8.00	per cent.

Nutritive Ratio, 1 : 1.9.

Average of Analyses of Skim Milk from Nov. 6, 1884, to Feb. 5, 1885.

[From the Experiment Station Farm.]

Water, ...	89.78	per cent.
Total solids, ...	10.22	"
	100.00	per cent.
Analysis of Solids:		
Fat, ...	0.33	per cent
Protein (nitrogenous matter), ...	3.53	"
Ash, ...	0.80	"
Non-nitrogenous extract matter, ...	5.56	"
	10.22	per cent.

Nutritive Ratio, 1 : 1.8.

The subsequent analysis represents the average of the composition of the corn meal fed during the previously-described feeding experiments with pigs.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.62	252.40	–	–	
Dry Matter, ...	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	1.56	31.20	–	–	
" Cellulose, . . .	2.66	53.20	18.09	34	
" Fat, ...	4 27	85.40	64.90	76	1 : 8.76
" Protein (Nitrogenous Matter), . . .	11.43	228.60	194.31	85	
Non-nitrogenous Extract Matter, . . .	80.08	1,601 60	1,505.50	94	
	100.00	2,000.00	1,782.00		

FIELD EXPERIMENTS.

C. A. GOESSMANN.

I.

Fodder Corn raised upon underdrained and exhausted Lands, partly Fertilized with Single Articles of Plant Food, partly without the use of any Manurial Matter.

[See Sketch A.]

The land turned to account for the experiment extended over an area of one and one-tenth acres, which was subdivided into eleven plats of an equal size, one-tenth of an acre each. It had served, for several years previous to the establishment of the Experiment Station in 1882, as a meadow for the production of hay. During the spring of 1883 it was underdrained, and subsequently planted with corn (Longfellow variety), for fodder corn, without the use of any fertilizer. The same course of planting and cultivation was carried out during 1884, changing from the Longfellow to the Clark variety of corn, for the purpose of exhausting the soil, as far as practicable, for the successful cultivation of corn.

The entire area (A) was separated by tile drain from the surrounding lands; each plat had, through its whole length (from west to east), in the centre, a separate tile drain, terminating on the east end, and communicating here, by means of a well, with a lower main drain, to permit, whenever desirable, a separate collection of samples of drainage waters from each individual plat for a subsequent chemical examination. This system of underdraining was to serve, in the progress of our work, for an inquiry into the retentive quality of our soil with reference to various articles of plant food.

As the corn crop raised in 1884 upon these eleven plats of unmanured lands had left no doubt about their exhausted

condition, as far as the farther cultivation of corn was concerned (see Second Ann. Rep. of Experiment Station, p. 84), it seemed advisable to begin the inquiry into the chemical and physical condition of the soil, as far as its relation to the production of the corn crop is concerned, as well as into its particular power to retain, in a higher or lower degree, various articles of plant food, i. e., its qualification to prevent their passage into the drainage water.

With these ends in view, the following course was decided upon, and has been carried out during the past season (1885):

The entire field (A) here under discussion was prepared May 12th in a similar manner for the planting of corn, as in preceding years.

Plat No. 0,	Received no manurial substance.
Plat No. 1,	Twenty-five pounds of sodium nitrate (= to 4 lbs. of nitrogen).
Plat No. 2,	Nothing.
Plat No. 3,	Thirty pounds of dried blood (= to nitrogen, 4 lbs.).
Plat No. 4,	Nothing.
Plat No. 5,	Twenty-five pounds of ammonium sulphate (= to 4 lbs. of nitrogen).
Plat No. 6,	Nothing.
Plat No. 7,	Fifty pounds of dissolved bone-black (= 8.5 lbs. available (phosphoric acid).
Plat No. 8,	Nothing.
Plat No. 9,	Twenty-five lbs. of muriate of potash (= to from 12 to 13 lbs. potassium chloride).
Plat No. 10,	48½ pounds potassa-magnesia sulphate (= to 12–13 lbs. potassium oxide).

The corn was planted May 16th, in furrows three feet and three inches apart, over the entire area, with the exception of Plat No. 6, which was left unseeded, to study the influence of the atmospheric agencies on the soil under cultivation without the assistance of growing plants. From six to eight kernels of one and the same lot (Clark variety) were dropped in one place, and at a distance of from twelve to fourteen inches from each other along each furrow. The young plants were thinned out subsequently, wherever advisable, and the entire field kept clean from weeds by a

timely use of the cultivator. Plat No. 6, being left unseeded, was kept clean from any kind of growth by the same means.

The seed corn proved satisfactory. The young corn appeared in all parts of the field at the same time, yet began soon to vary in height and color on different plats. The plants on Plat No. 1 were, July 11th, twelve inches high and of a fair color; only eight inches high and of a pale, sickly color on Plats Nos. 2, 3, 4 and 5; from eight to twelve inches high and pale looking on Plats Nos. 7 and 8; whilst on Plats Nos. 9 and 10 they were twelve inches high, of a good color, and strong and vigorous in general appearance.

On July 24th the plants on Plat No. 1 were fairly even and two and one-half feet tall; on Plat No. 2 only from one to two feet high; on Nos. 3 and 4 similar to those on Plat No. 2; on Plat No. 5 somewhat larger and of better color than on Nos. 3 and 4; on Plats No. 7 and 8 uneven and of a yellow color; and on Plats No. 9 and 10 alike of good color, forming a striking contrast to those on the other plats.

On August 5th the plants on Plats No. 1, 2, 3, 4 and 5 appeared all alike, dwarfed, from two to three feet high, with shrivelled leaves, abortive tassels, and but few ears; on Plats No. 7 and 8 a similar condition was noticed, with a few tassels, but no silk. The plants on Plats No. 9 and 10 were well tasselled and silked, quite tall and vigorous, and second only in appearance to corn of the same variety on well manured fields. On September 3d no material difference could be noticed between the growth of Plats No. 0, 1, 2, 3, 4, 5, 7 and 8. The plants were withered from a yellowish to a brown color, with but a few and small ears, containing watery kernels. The corn on Plats No. 9 and 10 was still green and of a luxuriant character, the foliage beginning to change color, whilst the complete ears were filled with kernels in the milk.

The growth on the entire field was cut September 5th, and the product of each plat stacked by itself in the field for drying; it was housed October 10th.

PLAT.	Amount of Dry Corn Fodder Obtained (pounds).	Fertilizer Applied.
No. 1,	480 lbs.	Nitrate of soda.
2,	310 lbs.	Nothing.
3,	350 lbs.	Dried blood.
4,	300 lbs.	Nothing.
5,	360 lbs.	Sulphate of ammonia.
7,	280 lbs.	Dissolved bone-black.
8,	250 lbs.	Nothing.
9,	945 lbs.	Muriate of potash.
10,	845 lbs.	Potassa-magnesia sulphate.

Comparing these results with those obtained in the previous year (5,040 lbs.), where the produce of the various plats was practically of a corresponding weight, — 458 lbs. each, — we notice that the application of potash compounds alone, muriate of potash leading (see Plats No. 9 and 10), has had a marked effect on the quantity and the quality of the corn fodder raised, increasing the last annual yield not less than one hundred per cent. above that of the preceding year (1884).

The amount of corn fodder raised on Plat No. 1, which received nitrate of soda, exceeded but slightly (22 lbs.) that of the previous season; whilst the application of blood, ammonium sulphate and phosphoric acid has not prevented a considerable falling off. The yield of corn fodder of fertilized and unfertilized plats was practically the same in most instances.

In sight of these facts it seems justifiable to conclude that a deficiency of the soil in available potassa controlled more than that of any other essential article of plant food the final yield of the crop. The experiment furnishes a good illustration of a one-sided exhaustion. Grass and fodder corn act in a similar direction on the mineral soil resources of plant food, — one part of phosphoric acid to four parts of potassa. In case circumstances necessitate a direct succession of these two crops it is well to remember that fact, and to provide against a failure by applying to the soil liberally, in particular, potash compounds in some form or other. Muriate of potash seems to deserve recommendation. The observation will be continued during the coming season.

Analyses of an Average Sample of Fodder Corn collected from Three Unfertilized Plats — Nos. 2, 4 and 8.

Moisture at 100° C.,	78.50	per cent.
Dry Matter,	21.50	"
	100.00	per cent.

Analysis of Dry Matter:

Crude Ash,	3.91	per cent.
" Cellulose,	25.74	"
" Fat,	2.92	"
" Protein (Nitrogenous Matter),	13.75	"
Non-nitrogenous Extract Matter,	53.68	"
	100.00	per cent.

Analyses of Fodder Corn from Underdrained Plats, with reference to Nitrogen and Mineral Constituents (Corn and Grain).

[Collected when harvested.]

1. *Mixed Sample from Three Unfertilized Plats — Nos. 2, 4 and 8.*

Analysis of Dry Matter.			Relative Percentage of Soluble Matter in Ash.	
Nitrogen,	1 96	per cent.	–	–
Crude ash,	3.49	"	–	–
Potassium oxide,	0.507	"	22.047	per cent.
Sodium oxide,	0.208	"	9.055	"
Magnesium oxide,	0.544	"	23.662	"
Calcium oxide,	0.455	"	19 764	"
Phosphoric acid,	0.526	"	22.953	"
Ferric oxide,	0.058	"	2.519	"
Insoluble and silicious matter,	1.123	"	–	–

2. *Sample from Plat Fertilized with Muriate of Potash — No. 9.*

[Collected when harvested.]

Analysis of Dry Matter.			Relative Percentage of Soluble Matter in Ash.	
Nitrogen,	1.77	per cent.	–	–
Crude ash,	6.26	"	–	–
Potassium oxide,	1.259	"	43.154	per cent.
Sodium oxide,	0.157	"	5.436	"
Magnesium oxide,	0.488	"	16.711	"
Calcium oxide,	0.545	"	18.658	"
Phosphoric acid,	0.397	"	13.625	"
Ferric oxide,	0.071	"	2.416	"
Insoluble and silicious matter,	1.614	"	–	–

3. *Sample from Plat Fertilized with Dissolved Bone-black — No. 7.*

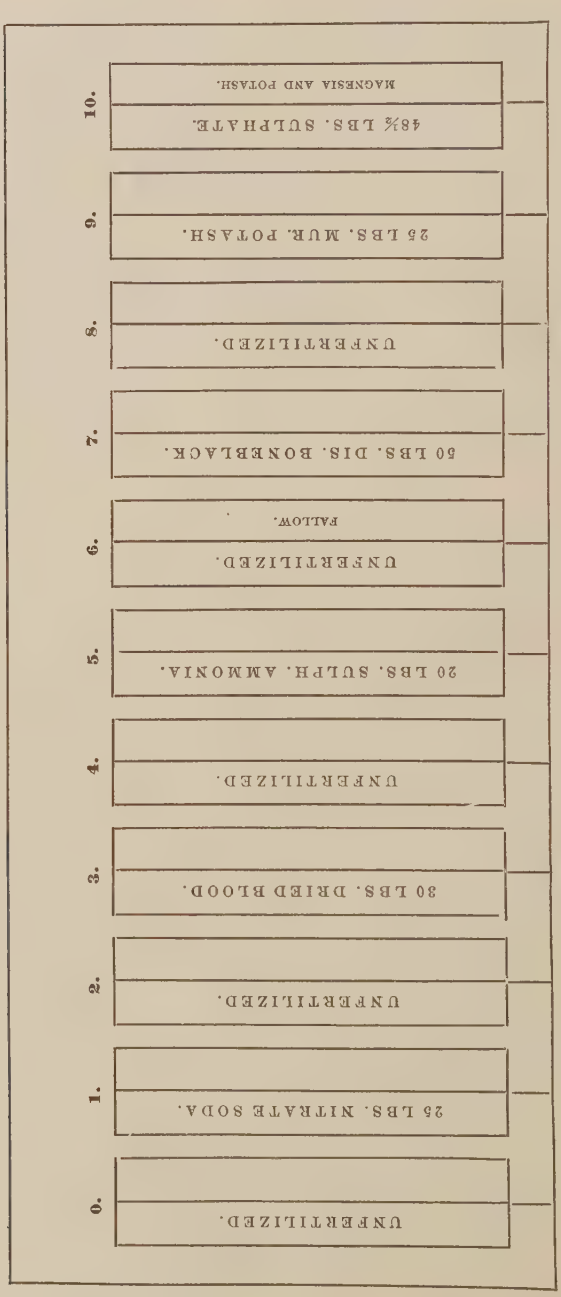
[Collected when harvested.]

Analysis of Dry Matter.		Relative Percentage of Soluble Matter in Ash.
Nitrogen,	1.99 per cent.	– – –
Crude ash,	4.92 "	– – –
Potassium oxide,	.47 "	16 876 per cent.
Sodium oxide,	.07 "	2.390 "
Magnesium oxide,	.77 "	27.488 "
Calcium oxide,	.78 "	27.760 "
Phosphoric acid,	.63 "	22.319 "
Ferric oxide,	.09 "	3.158 "
Insoluble and silicious matter,	1.99 "	– – –

4. *Sample from Plat Fertilized with Sulphate of Ammonia — No. 5.*

[Collected when harvested.]

Analysis of Dry Matter.		Relative Percentage of Soluble Matter in Ash.
Nitrogen,	2.01 per cent.	– – –
Crude ash,	5.08 "	– – –
Potassium oxide,	.52 "	19.664 per cent.
Sodium oxide,	.06 "	2.276 "
Magnesium oxide,	.81 "	30.792 "
Calcium oxide,	.60 "	22.588 "
Phosphoric acid,	.60 "	22.659 "
Ferric oxide,	.05 "	2.024 "
Insoluble and silicious matter,	1.19 "	– – –


"SKETCH A."
0.
UNFERTILIZED.
1.
25 LBS. NITRATE SODA.
2.
UNFERTILIZED.
3.
30 LBS. DRIED BLOOD.
4.
UNFERTILIZED.
5.
20 LBS. SULPH. AMMONIA.
6.
UNFERTILIZED.
FALLOW.
7.
50 LBS. DIS. BONEBLACK.
8.
UNFERTILIZED.
9.
25 LBS. MUR. POTASH.
10.
48½ LBS. SULPHATE.
MAGNESIA AND POTASH.
Corn Plats with Drainage System. Scale, 4 rods to 1 inch

II.

Influence of Fertilizers on the Quantity and Quality of some prominent Fodder Crops.

[See Sketch B.]

The earlier history of the field (B) which has been reserved for these experiments, as well as a description of the general plan adopted regarding the latter, was outlined in the Second Annual Report, pages 85 and 86.

The entire field was ploughed and harrowed May 12, and snbsequently subdivided, in the same manner as in the preceding years, into eleven plats of corresponding size, — one-tenth of an acre each. Plats No. 11, 13, 15, 17, 19 and 21 each received, as in the previous year, a mixture of sixty pounds of steamed ground bones and of twenty pounds of muriate of potash; whilst Plats No. 12, 14, 16, 18 and 20 received no manurial matter as fertilizer. The latter had not been fertilized for two preceding years. The fertilizer, applied broadcast to each alternate plat, as above stated, was slightly harrowed under before seeding.

Indian Corn. — The observations concerning the development of the Indian corn, and its general character at various stages of growth, have been continued in this connection for the purpose of furnishing a more reliable basis for the decision of the question, — At what period of its growth is it best to harvest the crop for either dry corn fodder or corn ensilage, considering in both cases the quality and quantity of the crop secured?

Plats No. 17, 18, 19, 20 and 21 served again, as in previous years, for the cultivation of corn. "Hampden Prolific" corn was planted in rows, May 16, in a similar way as described in connection with the corn experiment upon underdrained plats (field A); *i. e.*, in rows three feet and three inches from each other, with from six to eight kernels in spots from twelve to fourteen inches apart, to allow a vigorous growth and a thorough, clean cultivation. The crop raised upon the fertilized Plats No. 17, 19 and 21 was to serve in part for ensilage; that obtained from the unfertilized Plats No. 18 and 20 was to be sold as dry fodder

corn; both crops were to be cut at the same time to compare results.

The seed corn planted proved a failure; but a few plants made in due time their appearance. An examination of the ground showed that maggots were feasting on the kernels. The rows were for this reason re-furrowed and replanted with "Clark" corn, — a variety which had been raised upon the same plats during the preceding year.

The young plants appeared on all the plats at about the same time; they differed, however, already, to a considerable degree, in size and general appearance, by the 11th of July. Those growing on fertilized plats were from 18 to 20 inches high, and of a vigorous appearance; whilst those upon unfertilized plats varied in height from 8 to 12 inches, and began to look pale. July 24, the former were from 3 to 4 feet high, and the latter from 2 to 3 feet. August 5, the former tasselled and began to form ears; the latter looked much inferior, and formed much smaller tassels. September 3, the plants upon the unfertilized plats looked withered, and had but a few small ears; the remainder of the corn, with kernels still soft and in part beginning to glaze, was every way very satisfactory.

The entire crop upon all plats was cut Sept. 4, 1885. The dry corn fodder secured from the fertilized plats averaged $5\frac{1}{6}$ tons per acre; and that from the unfertilized plats in this connection obtained $3\frac{1}{10}$ tons for the same area.

The subsequent analytical statement shows quite strikingly the changes which take place in growing corn. The material prepared for the analyses was taken from average specimens of the entire plant at the time of collection.

Determination of Solids in Fodder Corn collected at different Stages of Growth.

	July 22.	July 29.	Aug. 5.	Aug. 13.	Aug. 27.	Sept. 3.
Moisture, . . .	88.61	85.76	84.64	82.08	81.15	76.81
Solids, . . .	11.39	14.24	15.36	17.92	18.85	23.19
	100.00	100.00	100.00	100.00	100.00	100.00

Composition of Dry Matter in the above Samples of Fodder Corn.

	July 22.	July 29.	Aug. 5.	Aug. 13.	Aug. 27.	Sept. 3.
Crude Ash, . . .	8.54	8.00	5.95	5.69	4.70	4.22
" Cellulose, .	26.01	27.29	26.40	24.11	24.30	20.93
" Fat, . . .	3.24	2.65	2.26	2.13	1.81	2.63
" Protein (Nitrogenous Matter),	17.19	14.42	11.86	11.23	8.87	9.17
Non-nitrogenous Extract Matter, . .	45.02	47.64	53.53	56.84	60.32	63.05
	100.00	100.00	100.00	100.00	100.00	100.00

Taking for granted that the digestibility of a fodder corn at the time when the seeds are still soft and just beginning to glaze, has been but little impaired as compared with that just sending out tassels, we find it but good economy to defer the cutting of the fodder corn to the first mentioned stage of growth. One ton of green fodder corn in tassel contained in our case 307.2 pounds of dry vegetable matter; whilst in the case of the seed just beginning to glaze, 463.8 pounds of dry vegetable matter are found in one ton, — a difference of 156.6 pounds in favor of the more matured state of the growth.

Pearl Millet (Penicillaria spicata.) — The Plats No. 13 and 14 were seeded down, May 16, in drills three feet and three inches apart. Plat No. 13 was fertilized previously with sixty pounds of steamed ground bones and twenty pounds of muriate of potash. Plat No. 14 was, as in the preceding years, left without the addition of any manurial matter. The seed germinated in seven days.

The growth on the fertilized Plat No. 13 soon took the lead in size and general appearance, and maintained that superiority until September 10, when the crop produced on both plats was cut for drying. The plants upon the fertilized soil were foliaceous and from six to seven feet high. They showed no sign of heads in blossom when cut; whilst those

grown upon the unfertilized Plat No. 14 were of an uneven height, had a somewhat yellowish tint of the foliage, and showed, by the frequent appearance of heads in blossom, a premature termination of growth.

The foliaceous character of this plant attracted our attention as deserving a trial in our climate. The plant is described, by Mr. H. W. Ravenel, in the annual report of the South Carolina Department of Agriculture for 1885, as a native, or naturalized annual, summer-growing grass of that State, needing cultivation for its best success. "The number of names (Egyptian, or Cat Tail, or Candle, or Pearl Millet) by which this old favorite is known, proves its popularity. 'A tall, erect, thick-stemmed grass. It grows to the height of six feet or more, and the stalk is terminated by a compact, dense, cylindrical spike resembling a common cat tail, frequently a foot or more in length, and an inch thick, which is studded with the small obovate sessile grains, surrounded at the base by an abundance of short, coarse hairs or bristles.' On rich lands it yields enormously. It repays more than most plants for high manuring and good treatment. The growth is rapid, and *frequent* cuttings may be made in the course of the season, if always done *before* the *jointed stalk begins to run upward* to form seeds. It is not well suited for hay, as the thick, succulent stalk is difficult to cure properly."

Our experience confirms these statements. The fertilized Plat No. 13 produced 1,870 lbs. of dried millet, or 18,700 lbs. ($9\frac{1}{3}$ tons) per acre; and the unfertilized Plat No. 14 (for three succeeding years without manure) produced 1,050 lbs. of the air-dried crop, or 10,500 lbs. ($5\frac{1}{4}$ tons) for a corresponding area.

The subsequent analyses show the composition of the products of both Plats Nos. 13 and 14 in an advanced state of growth; too far advanced to be relished by our cows as dry fodder, yet well fitted for an acceptable ensilaged fodder.

Analyses of Pearl Millet.

[Collected Sept. 10, 1885.]

	Fertilized Plat No. 13.	Unfertilized Plat No. 14.
Moisture at 100° C.,	76.37	77.21
Dry Matter,	23.63	22.91
	100.00	100.00

PEARL MILLET.

[From Fertilized Plat of the Experiment Station. Collected Sept. 10, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutrilive Ratio.
Moisture at 100° C.,	7.80	156.00	–	–	
Dry Matter,	92.20	1,844.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.68	133.60	–	–	
" Cellulose,	34.31	686.20	–	–	
" Fat,	1.47	29.40	12.35	42	1:7.15
" Protein (Nitrogenous Matter),	7.88	157.60	94.56	60	
Non-nitrogenous Extract Matter,	49.66	993.20	645 58	65	
	100.00	2,000.00	752.49	–	

PEARL MILLET.

[From *Unfertilized* Plat of Experiment Station. Collected Sept. 10, 1885.]

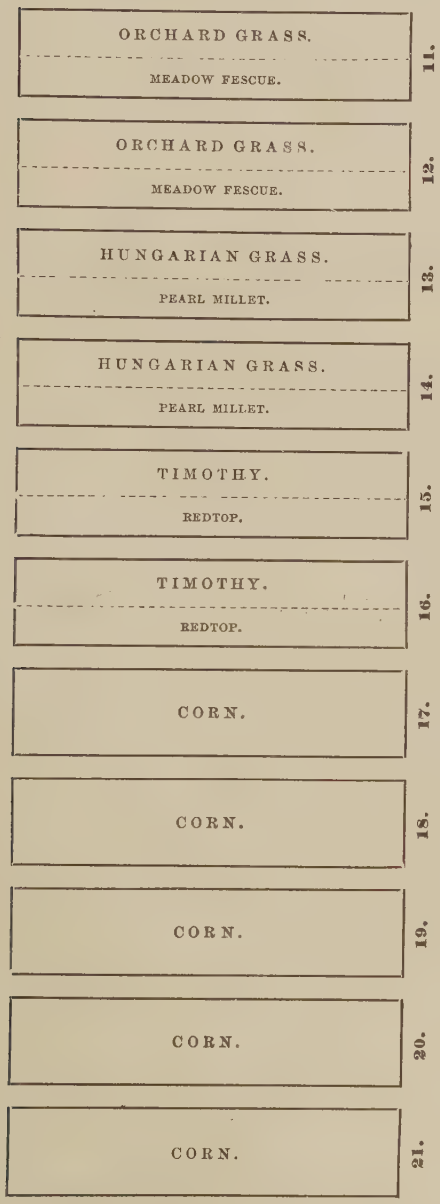
	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.10	162.00	–	–	
Dry Matter,	91 90	1,838.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.08	141.60	–	–	
" Cellulose,	34.30	686.00	–	–	
" Fat,	.89	17.80	7.48	42	1:6.8
" Protein (Nitrogenous Matter),	8.11	162.20	97.32	60	
Non-nitrogenous Extract Matter,	49.62	992.40	645.06	65	
	100.00	2,000 00	749.86	–	

The cultivation of the pearl millet will be continued during the coming summer season, to test its economical value as a green fodder at an earlier stage of growth.

Grasses. — The character of the growth which had gradually sprung up in four Plats No. 11, 12, 15 and 16, set apart for the production of four single varieties of grasses (see Second Report, pp. 84 and 85), — orchard, meadow fescus, timothy and red-top, — rendered a change of cultivation desirable. These grasses had been seeded down broadcast, each separate from the other, in May, 1884, for the purpose of studying their respective fodder value, etc. A great variety of grasses, and of other species of plants, had gradually made their appearance, which rendered a separation in the course of time impracticable. The unfertilized Plats No. 12 and 16 were in a worse condition than the fertilized Plats No. 11 and 15. As drill culture promised better results, it was decided to turn the sod soon after the first hay crop was removed, and to reseed subsequently in drills two feet apart.

The reseeding took place Aug. 26, 1885. The young grasses looked well in the fall. They have been kept clean

SKETCH "B."



Corn and Grass Plats. Scale, 4 rods to 1 inch.

by means of a frequent use of the cultivator and by hand weeding.

The same course will be pursued hereafter until a suitable material has been secured for a comparative examination regarding their individual merits, as well as the best stage of growth for harvesting, as far as quality and quantity of the crop is concerned.

III.

Fodder Corn for the Silo.

The land used for the raising of ensilage corn extended over an area of 1.06 acres, which had been used for some years for the production of grass for hay. It was ploughed and properly prepared, early in the season, and manured with from ten to twelve loads of barnyard manure, supplemented by three hundred and fifty pounds of ground bones and two hundred pounds of high-grade potash compounds.

This course of manuring was adopted merely for the purpose of turning material on hand to good account. The land was to be laid down again into grass after harvesting the corn.

The latter (Clark variety) was planted May 28, in drills three feet and three inches apart. From six to eight kernels were dropped into spots from twelve to fourteen inches apart; and the young plants subsequently thinned out to permit good development of every plant. The seed corn proved to be good, and the crop was ultimately in every way a success. The young corn was kept clean from weeds by means of a cultivator until July 11, when the whole area was seeded down into grass, using one-half of one bushel of timothy and one bushel of red-top. Some parts of the field had to be reseeded after the corn was removed, on account of a localized dense growth of the latter, which prevented the grass seed from coming up in a satisfactory degree.

The corn fodder, when cut for the silo, September 3 and 4, began to acquire a slightly yellowish tint along the outside of the field, yet was still green and succulent in the interior parts; the kernels were soft, their contents somewhat milky, and their outside just beginning to glaze. This condition of

the corn crop is, as has been shown on previous occasions, the best adapted for the production of corn ensilage. The corn contained: —

	Per Cent.
Moisture at 100° C.,	70.81
Dry Matter,	29.19
	100.00

Corn Ensilage. — Two silos of a corresponding size, five by fourteen feet, inside measure, and eleven feet deep, were used for the experiment. In both instances the corn was cut into pieces from one and one-quarter to one and one-half inches in size; they were, however, filled in a different way.

The silo on the west side was filled to a depth of from eight to nine feet, as fast as the cut corn could be supplied and tramped down. As soon as the amount of corn assigned for that silo (9.5 tons) was filled in, the surface was carefully covered with tarred paper and tight-fitting boards, and at once pressed down with twenty-five barrels of sand. A maximum registering thermometer was safely buried at a depth of about two feet in the mass, to record the highest temperature which the latter would reach during the time of keeping the silo closed.

The silo on the east side was, September 4, loosely filled to about two-thirds of its height, and the mass merely levelled without treading it down. It was left in this condition, without covering, until September 7, at 8 o'clock A.M. At this time it had settled from eighteen to twenty-four inches; the odor of acetic acid became slightly perceptible, and the pieces of cornstalk, although sweet to the taste, showed an acid reaction to the litmus paper.

Sept. 7, 8 A.M.	Temperature at	6	inches	depth,	132°, 144°, 138°	– F.
" 7, 8 A.M.	"	" 12	"	"	147°, 145°, 147°	– F.
" 7, 8 A.M.	"	" 18	"	"	140°, – –	– F.
" 7, 5 P.M.	"	" 6	"	"	129°, 134°, 147°,	131° F.
" 7, 5 P.M.	"	" 12	"	"	136°, 145°, 131°,	147° F.
" 8, 8 A.M.	"	" 6	"	"	129°, 141°, 138°,	113° F.
" 8, 8 A.M.	"	" 12	"	"	141°, 145°, 145°	– F.
" 8, 8 A.M.	"	" 24	"	"	136.5°, – –	– F.
" 8, 8 A.M.	"	" 30	"	"	114°, – –	– F.
" 8, 8 A.M.	"	" 36	"	"	107°, – –	– F.

As the temperature remained practically at a standstill, the filling in of more fresh-cut corn was resumed, and the silo completely, yet loosely, filled September 8. A maximum registering thermometer was buried in the mass at a depth of two feet from the surface, and light boards loosely laid upon the top.

Sept.	10, 8 A.M.	Temperature at	6	inches	depth,	122°, 123°, 125° F.
"	10, 8 A.M.	"	" 12	"	"	129°, 127°, – F.
"	10, 4 P.M.	"	" 6	"	"	118°, 130°, 131° F.
"	10, 4 P.M.	"	" 12	"	"	120°, 127°, 129° F.

The mass had now settled eighteen inches.

Sept.	11, 8 A.M.	Temperature at	6	inches	depth,	127°, 131°, 133° F.
"	11, 8 A.M.	"	" 12	"	"	127°, 129°, 131° F.
"	12, 8 A.M.	"	" 6	"	"	125°, 131°, – F.
"	12, 8 A.M.	"	" 12	"	"	122°, 132°, – F.

The mass had settled from twenty-four to thirty inches. The temperature remained practically the same; the mass was covered carefully with tarred paper and tight-fitting boards, in the same manner as in case of the first silo, and subsequently pressed down with twenty-five barrels of sand, September 12. This silo contained eight tons of green corn fodder.

The temperature observations above recorded were made in different parts of the silo; they show that it is quite difficult to secure a desirable uniform temperature within the mass in all parts of the silo, at the same depth and at the same time.

A description of the quality of the ensilage from both silos, with a record of highest temperatures attained in both cases, after closing the silos, will be published hereafter in the bulletins of the Station, as soon as the silos are opened for use.

It is proposed to compare, during the present winter season, the feeding effect and economy of a good corn ensilage with that of a good root crop.

IV.

Observations Concerning the Adaptation of some Prominent Fodder Crops new to our Section of the Country.

In preceding reports has already been urged the desirability of introducing into our agricultural industry a greater variety of fodder plants, to supplement and increase the products of pastures and meadows, and of the corn in its various forms as a fodder article.

The great interest so generally manifested in later years in the products of the silo is but a strong expression in favor of the view taken in this matter. Every progressive farmer deprecates the present condition of our fodder supply, as far as an economical support of a fair proportion of live stock, in the interest of a remunerative farm management, is concerned. Whether this result can be obtained in a satisfactory manner by increasing the production of one crop, although the most promising one in our section, is open to grave doubts. To raise corn for the silo has, no doubt, in many instances afforded a temporary relief, and thus not infrequently proved a valuable helpmate in compounding an economical diet for cattle.

Considering, in a mixed farm management, merely the temporary crop-producing fitness of the soil under cultivation, much may be said in favor of the endeavor to increase the area devoted to the production of corn fodder, and to preserve the product in a palatable condition for cattle feed, if thought best; for the Indian corn stands in the front rank of our fodder plants, as far as the annual production of vegetable matter is concerned.

Quite different, however, must be our judgment, when we consider the serious consequences of a too frequent raising of the same crop upon the same soil, on the future productiveness of the latter; or when we keep in mind the fact that neither corn, nor any other agricultural plant, furnishes a complete article of fodder in all cases.

True economy in farm practice requires that we should cultivate our farm crops in such an order of succession that

the natural resources of the soil and of the air may be turned to account, as far as practicable, to their full extent. On the other hand, each single article of fodder needs supplementing with reference to the particular wants of the various kinds, ages and functions of the animals kept on the farm, in the interest of the highest remunerative return.

Some fodder crops prosper on one kind of soil, others upon another. To procure the largest amount of valuable vegetable matter at the lowest expense is, then, only possible when perfectly safe crops, as far as climate and soil are concerned, are selected. It is the ultimate object of previous and present statements made under the heading of this chapter, to assist in selecting, for local trials, suitable fodder plants of well established reputation in other sections of our country, as well as of Europe. (See Second Report, pp. 89–100.)

Horse Bean (*Vicia Faba*. L.). — Some of the characteristics of this valuable plant have been described in the last annual report (pages 97–100). The analyses of the matured plant — straw and beans — were published on that occasion. During the past season their fitness for a mixed fodder with barley and oats, has been tested, and also their application as a green manure.

The field, .98 of an acre in size, which had been occupied during the past years by a variety of leguminous plants and some roots, was ploughed April 21st, and manured with a mixture of steamed ground bones and muriate of potash, at the rate of six hundred pounds of the former and two hundred pounds of the latter per acre. The fertilizer was applied broadcast and incorporated by the harrow.

The field was subsequently subdivided into two equal parts, .49 of an acre each in size. One part served for the production of a mixed crop of horse bean and oats, and the other for that of horse bean and barley. The crops resulting were to be cut at blooming, and were destined to serve as a fodder constituent in future feeding experiments.

Horse Bean and Oats. — Two bushels of oats and twenty-four quarts of horse beans were sown broadcast, April 25th, and harrowed under. Both seeds came up quite evenly and began blooming about June 12th, or within from forty-five to fifty days from the day of seeding.

The crop was cut before the oats were fully matured, July 9th. The yield amounted to 2,800 pounds, or 1.4 ton of hay, containing from 15 to 18 per cent. of moisture.

Analyses of Green Oats and Green Horse Bean when cut, July 9, 1885.

	Oats.	Horse Bean.
Moisture at 100° C.,	69.45	84.88
Dry Matter,	30.55	15.12
	100.00	100.00

HORSE BEAN.

[Collected in bloom from Plats of the Station, July 9, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	84.83	1,696.60	–	–	
Dry Matter,	15.17	303.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.75	115.00	–	–	
" Cellulose,	28.17	563.40	–	–	
" Fat,	2.31	46.20	30.95	67	1 : 2.71
" Protein (Nitrogenous Matter),	16.68	333.60	236.86	71	
Non-nitrogenous Extract Matter,	47.09	941.80	565.08	60	
	100.00	2,000.00	832.89	–	

Analyses of matured horse bean, and of straw and pods, have been reported in the Second Annual Report, pages 98 and 99.

HAY OF OATS.

[From Plats of Station, cut while in milk, July 9, 1885.]

	Per centage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.55	191.00	–	–	
Dry Matter,	90.45	1,809.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.08	121.60	–	–	
" Cellulose,	34.32	686.40	–	–	1:7.9
" Fat,	2.69	53.80	24.75	46	
" Protein (Nitrogenous Matter),	10.89	217.80	124.15	57	
Non-nitrogenous. Extract Matter,	46.02	920.40	920.40	100	
	100.00	2,000.00	1,069.30	–	

Some of the green crop was used in a feeding experiment with milch cows previous to the time of cutting for hay.

Horse Bean and Barley. — Forty-nine one hundreths of an acre of land, ploughed and manured in connection with the field which served for the production of horse bean and oats, was seeded down with one and one-half bushels of barley and one-half a bushel of horse bean, May 7. The day of seeding was delayed on account of the late arrival of the barley. The advanced season hastened the growth of both barley and horse bean. The latter began to bloom in but one week after that seeded in connection with the oats; the barley was fully in head June 20. The crop was cut when the barley grain was still in the milk, July 8, and yielded, when housed, 2,900 lbs. of dry fodder, or 1.45 tons, containing still from 15 to 18 per cent. of moisture.

Analyses of Green Barley and Green Horse Bean when cut, July 9.

	Barley.	Horse Bean.
Moisture at 100° C., ...	57.73	84.88
Dry Matter, ...	42.27	15.12
	100.00	100.00

HAY OF BARLEY.

[The barley was cut July 9, 1885, while the seeds were in the milk.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.25	205.00	–	–	
Dry Matter, ...	89.75	1,795.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	4.95	99.00	–	–	
" Cellulose, . . .	29.12	582.40	–	–	
" Fat, ...	2.76	55 20	25.39	46	1 : 9.59
" Protein (Nitrogenous Matter), . . .	10.26	205.20	116.96	57	
Non-nitrogenous Extract Matter, ...	52.91	1,058.20	1,058.20	100	
	100.00	2,000.00	1,200.55		

Part of the crop was fed green in connection with a feeding experiment with milch cows.

Analysis of horse bean, see above.

To raise a mixture of fodder plants upon one and the same field has proved, in many instances, good economy; the total yield is in most instances larger than if each crop had been raised by itself. The practice of raising some of our grain crops, together with different kinds of leguminous plants, — as clover, vetch, beans, peas, etc., — deserves the serious consideration of our farmers.

A proper selection of mixed crops for fodder can not only substantially aid, in the earlier part of the summer season, in

furnishing nutritious green fodder to the dairy when pastures may fail and green corn fodder fit for an economical consumption cannot yet be had; but, converted at a proper time into hay, they can also materially increase the stock of valuable winter fodder.

The addition of foliaceous fodder plants to those of a scanty leaf development insures, frequently, a success of the latter, when an exceptional dryness of the season may endanger a satisfactory result. A mixture of clover and grass may be a success where either clover or grass, alone, would be a doubtful crop. They frequently tend to improve also the general chemical and physical condition of the soil they grow on, and render it thereby better fitted for a successful cultivation of winter grains. Winter and summer grains are most frequently cultivated together with varieties of vetches, field beans, field peas; buckwheat, also, frequently enters into the mixture. The early harvesting of most of these mixtures leaves ample time for the preparation of the soil for winter crops.

The proportion in which the seeds of the different crops ought to be mixed depends somewhat on the cost of the seed. In case the seeds of leguminous plants are cheap, it is advisable to let the mixture consist of two-thirds leguminous plants to one-third of cereals; whilst, in case the leguminous seeds are costly, one-half of leguminous plants and one-half of cereal plants. The scanty supply of horse bean seed obliged us to depart from the previous recommendation.

After both crops had been housed, the field was at once ploughed, and, after being manured with one-half the quantity of fertilizer used for the production of the first crop, seeded down, broadcast, July 16, with thirty-four pounds of Hungarian grass seed.

The young plants made their appearance July 22; they began to head out August 5, and reached the height of from twenty to twenty-four inches September 3.

The crop was cut for hay September 8; it amounted to 2,395 lbs., or 2,444 lbs. of hay per acre, as a second crop for the season.

HUNGARIAN GRASS.

(PANICUM GERMANICUM.)

[Collected in bloom from the Plats of the Station, Sept. 3, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.07	1,481.40	–	–	
Dry Matter,	25 93	518.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.15	143.00	–	–	
" Cellulose,	24.66	493.20	–	–	
" Fat	1.01	20.20	8.48	42	1:6.86
" Protein (Nitrogenous Matter),	9.38	187.60	112.56	60	
Non-nitrogenous Extract Matter,	57.80	1,156.00	751.40	65	
	100.00	2,000.00	872.44	–	

Horse Bean and White Lupine for Green Manuring. — A piece of land adjoining the experimental plats, represented in sketch B, was to be added to the latter to lengthen out the several plats, to give them a more desirable form for the comparative study of crops. The soil was worn out by a continuous raising of grass for hay; the annual yield of the hay had fallen off to one-half a ton per acre, and the last crop had ripened prematurely. No manurial matter could be added to the soil in consideration of the purpose it was to serve hereafter. To let it lay idle until it was best to sow the grass seed for experimental purposes was thought not advisable.

The worn-out condition of the soil suggested the idea to experiment with some leguminous plants, reputed for their efficiency as green manures, and to prepare the land, in this connection, by drill culture, for its future work. To accomplish this end, the grass land, .64 of an acre in size, was ploughed during the first week of May, and the soil subsequently thoroughly broken up by the wheel harrow. One-half of the field was planted May 16, in drills three feet and

three inches apart, with horse beans; and the other with white lupine. The seeds used, in both instances, were obtained from our previous experiments with these plants; they proved very satisfactory. Both plants — horse bean and white lupine — are hardy and mature well in our section of the country.

The fields were kept clean from weeds by frequent use of the cultivator. The horse bean began to bloom during the first week of July, and had already attained, July 15, a height of from twenty-four to thirty inches. The lupine had at that time only reached a height of eighteen inches, and showed no sign of blossoms.

Both crops looked remarkably well, and had attained a height of about three feet July 22, when they were ploughed under.

A part of the field not needed for the enlargement of the experimental plats was subsequently laid down in grass — red-top and herdsgrass — August 20; it proved at the close of the season to be one of the best appearing grass plots on the ground.

Ash Analysis of Horse Bean.

[Collected July 15, 1885, when in bloom.]

	Per cent.
Moisture at 100° C.,	74.71
Dry Matter,	25.29
	100.00

Ash Constituents in Dry Matter.

	Per cent.
Potassium oxide,	1.37
Sodium oxide,	.09
Calcium oxide,	1.37
Magnesium oxide,	.62
Ferric oxide,	.20
Phosphoric acid,	.33
Insoluble matter,	2.04

Analyses of matured horse bean, and of straw and pods, have been reported in Second Annual Report, pages 98 and 99. For analysis of horse bean in bloom, see above.

White Lupine (*Lupinus albus*).

[Collected when in bloom from Experimental Plats of the Station, 1884.]

	Per cent
Moisture at 100° C.,	85.35
Dry Matter,	14.65
	100.00

Analysis of Dry Matter.

	Per cent.
Crude Ash,	5.03
" Cellulose,	31.18
" Fat,	2.41
" Protein (Nitrogenous Matter),	18.71
Non-nitrogenous Extract Matter,	42.67
	100.00

	Per cent.
Potassium oxide,	1.73
Sodium oxide,	.68
Calcium oxide,	3.07
Magnesium oxide,	.73
Ferric oxide,	.17
Phosphoric acid,	.35
Insoluble matter,	.90

The frequent occurrence of a natural dense growth of a blue variety of wild lupine, on sandy, unimproved, unproductive lands along the Connecticut River, suggested the idea of trying the above described improved variety as a green manure for the reclamation of abandoned farm lands in neighboring districts.

The white lupine enjoys a high reputation as a green manure upon a light, dry, sandy soil. The first season (1884) was used for raising seeds; and the second for testing its value as a green manure.

Luzerne (Alfalfa). — Two varieties of this well-known fodder plant — *Medicago sativa* and *Medicago media* — were cultivated during the preceding year. Both were seeded down broadcast at the same time; they came up quite evenly. *Medicago media* or sand luzerne soon, however, took the lead; they both produced fair crops.

The plants passed well through a severe winter. As the appearance of a foul growth rendered the continuation of the experiment of doubtful benefit, it has been decided to repeat the trial by seeding in drills to secure a better chance for clean cultivation.

LUZERNE.

(ALFALFA; MEDICAGO SATIVA.)

[Collected, when just beginning to bloom, from Plats of the Station, July 2, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	16.00	320.00	–	–	
Dry Matter,	84.00	1,680.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	10.45	209.00	–	–	
" Cellulose,	25.42	508.40	203.36	40	1 : 4.71
" Fat,	2.50	50.00	19.50	39	
" Protein (Nitrogenous Matter),	16.34	326.80	251.64	77	
Non-nitrogenous Extract Matter,	45.29	905.80	588.77	65	
	100.00	2,000.00	1,063.27	–	

The green material contained 77 parts of moisture and 23 parts of vegetable matter. The sample for analysis was taken from the first growth, when in blossom. The composition of the Luzerne hay compares favorably with that of a first-class hay of red clover in blossom. The past winter has tested severely the adaptation of this valuable fodder plant to our climate. The plant is noted for its resistance to drought, wherever its extensive root system freely develops.

SAND LUZERNE.

(MEDICAGO MEDIA.)

[From the Plats of the Station; colleeted in bloom, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.80	176.00	–	–	
Dry Matter,	91.20	1,824.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	9.57	191.40	–	–	
" Cellulose,	21.27	425.40	170.16	40	1 : 3.5
" Fat,	2.59	51.80	20.20	39	
" Protein (Nitrogenous Matter),	16.26	325.20	250.40	77	
Non-nitrogenous Extract Matter,	50.31	1,006.20	654.03	65	
	100.00	2,000.00	1,094.79	–	

This variety, on the whole, gave better results than the former.

Cow Pea (Dolichos). — Experiments with two prominent varieties — Clay and Whippoorwill — have been described in the preceding annual report. The valuable qualities of these plants, as a green manure, as a green fodder, and as an efficient means, if cultivated in drills, to keep down weeds, has also been alluded to in that connection.

The following varieties of seeds of peas were secured, during the past season, from North Carolina and Mississippi, and planted May 27th and June 6th, to continue our observations regarding their respective merits: —

Cow Pea (Whippoorwill variety).
Cow Pea (Clay variety).
Black Stock Pea.
Conch Pea.
Chinese Prolific Pea.
Rice Pea.

All came up well and sent out runners by August 5th; most of them branched out subsequently, profusely, and

represented, September 21st, a dense green mass from two and a half to three feet high, with runners frequently from five to six feet long. Most of them were, at that period, in full blossom, and some matured subsequently a few pods.

The Clay and Whippoorwill seemed, on the whole, with us, the leading varieties; all varieties suffered severely from the first frost, October 8th. They were relished as fodder by cows, in the green as well as the dried state.

Experiments in this direction will be continued. A variety maturing three weeks earlier has been promised by a friend in North Carolina for the coming season.

Three analyses of Cow Peas, raised on another occasion, will be found in the Second Annual Report, pages 91–93.

Aside from the previously described observations, some interesting facts have been obtained during the past season with regard to the cultivation of Vetches (*Vicia sativa*), Serradella (*Ornithopus sativus*, Brot.), Saintfoin or Esparsette (*Onobrychis sativa*), Blue and Yellow Lupine, Evergreen Millet (Denver, Colorado), Summer Rape and Winter Rape (*Brassica napus*).

V.

Experiments with Potatoes.

Var.: Beauty of Hebron.

The arrangement of the field, the mode of manuring, and the variety of potatoes raised have been the same as in the preceding season. (See Second Annual Report, pp. 87–89.) The three plats set aside for the experiment, each one-fifth of an acre in size, were prepared for the experiment, and planted April 27th. Plat No. 1 received, as fertilizer, thirty pounds of muriate of potash and one hundred and thirty pounds of steamed fine-ground bones; Plat No. 2 received no fertilizer; Plat No. 3 was fertilized with fifty-eight pounds of potassa-magnesia sulphate and one hundred and twenty pounds of fine-ground bones. The rows were three feet and three inches apart, and the seed potatoes dropped from eighteen to twenty-four inches in the rows. One-half of each plat was planted with medium-sized whole potatoes; one-half with half a potato in the spot.

The young crop was hoed June 9th. The difference in the appearance of the plats was quite marked, July 24th; the plat (No. 1) with muriate of potash had the largest foliage and looked darker green than the remainder; that with potash sulphate (No. 3) looked next best. A blight on the leaves, which showed itself during the first week of August, terminated prematurely the experiment; the vines upon all plats died soon after. The crop was harvested August 26th, with the following results: —

PLAT No. 1.

SEED POTATO.	Fertilizer Applied.	Yield of Potatoes upon One-Fifth of an Acre, in Pounds.		
		Large.	*Small.*	*Total.*
Whole Potato, .	120 lbs. ground bones and 30 lbs. muriate of potash.	705	355	1,060
One-half a Potato,		695	270	965
		1,400	625	2,025

PLAT No. 2.

		Large.	*Small.*	*Tota*
Whole Potato, .	Not Fertilized.	335	350	685
One-half a Potato,		255	270	525
		590	620	1,210

PLAT No. 3.

		Large.	*Small.*	*Total.*
Whole Potato, .	120 lbs. of bone and 58 lbs. potassa-magnesia sulphate.	605	490	1,095
One-half a Potato,		540	580	1,120
		1,145	1,070	2,215

The potatoes from all the plats suffered severely from *scab*.

Determination of Solids in Potatoes.

JULY 24.

	From Plat No. 1.	From Plat No. 2.	From Plat No. 3.
Moisture at 100° C., ...	81.44	79.49	79.39
Solids, ...	18.56	20.51	20.61
	100.00	100.00	100.00

AUGUST 5.

Moisture at 100° C., ...	80.96	81.04	79.36
Solids, ...	19.04	18.96	20.64
	100.00	100.00	100.00

AUGUST 27.

Moisture at 100° C., ...	79.85	80.60	80.61
Solids, ...	20.15	19.40	19.39
	100.00	100.00	100.00

The large proportion of small potatoes, unfit for the market, which have been obtained in particular from Plats No. 2 and 3, show not less a premature termination of a healthful condition of the entire crop, than the low percentage of solids in the potatoes harvested. The normal growth of the tuber came apparently to a standstill soon after the first examination for solids had been made.

A well-matured potato contains on an average twenty-five per cent. of solid matter. What exact relation "blight" and "scab," or both, bear to failure of the crop, is a question claiming deservedly our serious attention.

Fodder Analysis of Potatoes,

[From Plat treated with Potassa-Magnesia Sulphate.]

Moisture at 100° C., ...	78.05
Solids, ...	21.95
	100.00

Analysis of Dry Matter.

Crude Ash,	4.63
" Cellulose,	1.98
" Fat (Ether Extract),	.83
" Protein (Nitrogenous Matter),	13.56
Non-nitrogenous Extract Matter,	79.00
	100.00

These results confirm the above expressed view, — the potatoes were not matured.

VI.

Experiments with Root Crops.

The importance quite generally conceded to the introduction of a liberal cultivation of root crops in a mixed farm management, wherever a deep soil and the general character of the climate favors their normal development, rests mainly on the following consideration: they furnish, if properly manured and cultivated, an exceptionally large quantity of valuable vegetable matter fit for fodder for various kinds of farm live stock, competing in this direction favorably with our best green fodder crops; and they pay well, on account of large returns for the necessary care bestowed upon them by a thorough deep cultivation to meet success.

The physical conditions of the soil, however favorable they may have been for the production of crops of a similar character, will suffer, if year after year the same system of cultivation is carried out. Diversity in the mechanical treatment of the soil, and change of season for such treatment, cannot otherwise but affect advantageously its mechanical condition and the degree of its chemical disintegration, promoting thereby its fitness for retaining inherent plant food, as well as its power of turning to account atmospheric resources of plant growth. The roots of the same plants abstract their food, year after year, from the same layer of soil, while a change of crops with reference to a different root system renders it possible to make all parts of the agricultural soil contribute in a desirable succession towards an economical production of the crops to be raised. Deep-rooting plants, like our prominent root crops, for this reason, deserve a

particular consideration in the planning of a rational system of rotation of crops.

The fodder supplied by roots, although somewhat peculiar in its composition when compared with that obtained from many of our prominent fodder plants, where the upper part of the plants furnishes the main bulk, may, nevertheless, serve as a very valuable constituent in the diet of various kinds of farm live stock, when properly supplemented by oil cakes, grain, bran, hay, etc.

The various kinds of roots usually raised on farms for feeding purposes, differ essentially in regard to the amount of dry vegetable matter they contain. Turnips contain from 7 to 8 per cent.; ordinary mangolds from 11 to 12 per cent.; improved varieties of beet roots, like Lane's, from 15 to 16 per cent.; good carrots from 15 to 16 per cent.; a good sugar beet from 18 to 20 per cent. of solids; or, in other words, one ton of an improved variety of ordinary sugar beets is equal to from two to two and one-half tons of ordinary turnips, as far as the amount of dry vegetable matter is concerned.

Modes of cultivation and of manuring exert a decided influence, in this direction, on the composition of the roots. Large roots of the same variety contain quite frequently less *solid* matter than the smaller ones. Close cultivation in the rows, in connection with the use of well-decayed manurial matter as fertilizer, tends to produce good results.

The difference in the amount of solids, as far as each kind of root is concerned, is otherwise due, in the majority of cases, to a more or less perfect maturity. A liberal manuring with potash and nitrogen, in connection with a scanty supply of phosphoric acid, is frequently the cause of immatured roots at the ordinary harvest time.

To raise roots the second year, after a liberal application of coarse barnyard manure, or the turning over of grass lands, with the assistance of some commercial phosphatic fertilizer in the interest of a timely maturity, is highly recommended by practical cultivators of sugar beets. To stimulate in the roots the production of the largest possible amount of sugar and starch must be the object of the cultivator, for these two

constituents of roots control, more than any other one, their increase in solids.

The roots which served for our analyses were raised under similar conditions, upon a loamy soil, in a fair state of cultivation, for the purpose of comparing their composition.

The amount of nitrogenous matter stated in the analyses is, in every case, obtained by multiplying the nitrogen found in the dried vegetable matter by 6.25. This course has been adopted to enable a comparison with analyses of roots made in previous years; for this reason no nutritive ratio has been stated. Root crops are known to contain, on an average, from 35 to 45 per cent. of their nitrogen in other forms than protein substances.

Examination of Sugar Beets.

VILMORIN.

	Weight of Root below Leaf Marks.	Specific Gravity of Juice.	Density: Brix Saccharometer.	Temperature.	Sugar in Juice as indicated by Polariscope.	Moisture at 100° C.	Dry Matter.
No. 1, . .	0 lb. 13¾ oz.	1.050	12°	24° C.	8.19%	85.35	14.65
No. 2, . .	1 lb. 3¾ oz.	1.060	15°	21.5° C.	12.04%	84.25	15.75
No. 3, . .	0 lb. 10 oz.	1.060	15°	21.°.C.	12.41%	83.55	16.45
No. 4, . .	0 lb. 15¼ oz.	Not	taken.	–	13.30%	80.47	19.53
No. 5, . .	0 lb. 12½ oz.	1.060	14.7°	19° C.	12.40%	84.11	15.89

Fodder Analyses of Vilmorin Sugar Beets.

	No. 2.	No. 3.	No. 4.	No. 5.
Moisture at 100° C.,	84.25	83.55	80.47	85.99
Dry Matter,	15.75	16.45	19.53	14.01
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude Ash,	4.65	4.53	3.85	4.27
" Cellulose,	6.98	6.75	6.45	5.77
" Fat,	.64	.68	.58	.61
" Protein (Nitrogenous Matter),	12.98	10.14	16.13	15.75
Non-nitrogenous Extract Matter,	74.75	77.90	72.79	73.60
	100.00	100.00	100.00	100.00

The low percentage of sugar noticed in some of the varieties is evidently more due to an unfavorable condition of the soil than the seeds.

LANE'S IMPROVED SUGAR BEET.

Weight of Root below Leaf Marks,	1 lb. 9¾ oz.
Specific Gravity of Juice,	1.060.
Density: Brix Saccharometer,	15.5°
Temperature,	26° C.
Sugar in Juice as indicated by Polariscope,	11.97%
Moisture at 100° C.,	83.57%
Dry Matter,	16.43

Fodder Analysis of Lane's Improved Sugar Beet.

Moisture at 100° C.,	83.57 per cent.
Dry Matter,	16.43 "
	100.00 "

Analysis of Dry Matter.

Crude Ash,	3.57 per cent.
" Cellulose,	5.27 "
" Fat,	.83 "
" Protein (Nitrogenous Matter),	17.44 "
Non-nitrogenous Extract Matter,	72.89 "
	100.00 "

YELLOW GLOBE MANGOLD.

Weight of Root below Leaf Marks,	1 lb. 1 oz.
Specific Gravity of Juice,	1.035
Density: Brix Saccharometer,	9.9°
Temperature,	25° C.
Sugar in Juice as indicated by Polariscope,	6.47 per cent.
Moisture at 100° C.,	88.27 "
Dry Matter,	11.73 "

Fodder Analysis of Yellow Globe Mangold.

Moisture at 100° C.,	88.27 per cent.
Dry Matter,	11.73 "
	100.00 "

Analysis of Dry Matter.

Crude Ash,	7.83 per cent
" Cellulose,	7.08 "
" Fat,	.73 "
" Protein (Nitrogenous Matter),	12.84 "
Non-nitrogenous Extract Matter,	71.52 "
	100.00 "

SOUTHERN PRIZE TURNIPS.

[Seed sent on by Department of Agriculture, Washington, D. C.]

Weight of Root below Leaf Marks,	0 lb 11¾ oz.
Sugar (sucrose), Fehling's test,	4.42 per cent.
Sugar (sucrose) after inversion,	4.43 "
Moisture at 100° C.,	91.77 "
Dry Matter,	8.23 "

The roots emitted a strong odor similar to that of horse radish. The fresh root contained sulphur equal to .07 per cent. of sulphuric acid.

Fodder Analysis of Southern Prize Turnip.

Moisture at 100° C.,	91.77 per cent.
Dry Matter,	8.23 "
	100.00 "

Analysis of Dry Matter.

Crude Ash,	7.85 per cent.
" Cellulose,	10.12 "
" Fat,	1.74 "
" Protein (Nitrogenous Matter),	9.67 "
Non-nitrogenous Extract Matter,	70.62 "
	100.00 "

Fodder Analysis of Carrots. (*Danvers.*)

[From Experiment Station Farm, Oct. 21, 1885.]

Moisture at 100° C.,	87.48 per cent.
Dry Matter,	12.52 "
	100.00 "

Analysis of Dry Matter.

Crude Ash,	4.92 per cent.
" Cellulose,	7.55 "
" Fat,	3.94 "
" Protein (Nitrogenous Matter),	9.63 "
Non-nitrogenous Extract Matter,	73.96 "
	100.00 "

Large Carrot.

[From the same Field.]

Moisture at 100° C.,	88.25 per cent.
Dry Matter,	11.75 "
	100.00 "

Small Carrot.

[From the same Field.]

Moisture at 100° C.,	86.72 per cent
Dry Matter,	13.28 "
	100.00 "

VII.

Miscellaneous Field Observations.

HAY

[From Station Fields, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000.	Pounds digestible in a ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.30	166.00	–	–	
Dry Matter,	91.70	1,834.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.12	122.40	–	–	
" Cellulose,	30.19	603.80	350.20	58	1 : 9.5
" Fat,	2.55	51.00	23.46	46	
" Protein (Nitrogenous Matter,)	9.75	195.00	111.15	57	
Non-nitrogenous Extract Matter,	51.39	1,027.80	647.51	63	
	100.00	2,000.00	1,132.32	–	

"TOPOVER CORN."

[From Fields of Experiment Station, 1885.]

The ear contained eight rows of kernels. Its average length was 9 inches, and its average weight 6.8 ounces. It consisted of 83 per cent. of kernels, and 17 per cent. of cob. The average weight of one kernel was .52 gram.

One hundred parts contained: —

	Corn Stover.	Corn (without cob).
Moisture at 100° C.,	25.00	11.55
Dry Matter,	75.00	88.45
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	6.12	1.47
" Cellulose,	36.10	1.96
" Fat,	2.49	6.61
" Protein (Nitrogenous Matter),	6 47	14.01
Non-nitrogenous Extract Matter,	48.82	75.95
	100.00	100.00

SORREL.

(Rumex Acetosella.)

The plants for the examination were collected during the month of June, when in blossom. The fresh plant contained in one hundred parts: —

	Per cent.
Moisture,	87.07
Dry matter,	11.93
Mineral constituents,	1.11
(Including some earthy matter, 0.158).	

The fresh plant contains no free volatile acid, — as acetic acid, etc. The strong acid reaction and taste of the juice of

the plant is largely, if not exclusively, due to the presence of acid combinations of oxalic acid with the alkalies, potassa and soda.

The soluble portion of the ash constituents contains the subsequent substances in the following relative proportions: —

	Per cent.
Potassium oxide,	19.35
Sodium oxide,	10.79
Calcium oxide,	47.53
Magnesium oxide,	8.99
Ferric oxide,	2.55
Phosphoric acid,	10.79
	100.00

The sudden appearance of this well-known plant upon lands which, during the preceding season, had been free from the objectionable weed, suggested the previously described examination into its chemical composition. A more systematic inquiry into the chemical character and the habits of many of our weeds cannot fail to give us, here and there, useful information regarding an intelligent course to lessen their chances of a luxuriant growth.

Good agricultural authorities in Europe state that this variety of sorrel does not grow upon a calcareous soil, but thrives upon a sandy soil of a medium state of fertility. They recommend a liberal application of lime or marl as an effective remedy to check its growth. Judging from the predominance of lime in the mineral constituents of the sorrel, as shown by the above analysis, it seems that the stated beneficial action of lime and marl, if true, has to be ascribed to their modifying influence on the physical and chemical condition of the soil, and not to a deficiency of lime as a special plant food.

The material serving for our analysis grew upon a light, sandy soil.

FRUITS AND GARDEN CROPS.

Most of the analyses of fruits published below were obtained in connection with an investigation inaugurated in 1875 to inquire into the relation of the more prominent mineral constituents of fruit-bearing plants, to the healthful condition of the whole plants and the quality of their fruits, for the purpose of demonstrating the necessity of a rational, and thus efficient, system of fertilization on the garden and orchard.

A series of communications, of more or less general interest, regarding grapes, peaches, currants, apples, etc., are contained in previous publications of the Massachusetts Agricultural College, the Report of the Secretary of State Board of Agriculture, and of the Director of State Experiment Station.

The work is to be continued, with a fair prospect of improved opportunities in consequence of more favorable financial condition of the Station.

The material for the analyses of Concord grape, cherry currants, white currants, blackberries, raspberries, and Lombard plums, was obtained from one and the same plat of the experimental field, in a moderately good state of cultivation, and for several years without the application of any special chemical manures. The blueberries were collected in the vicinity of Amherst, from a soil largely of granitic origin. The material for the examination of apples — juice and pomace — came from outside sources, as specified in each case.

Concord Grape.

[From Experimental Plats on College Grounds.]

Relative Percentage of Essential Ash Constituents.

	Per cent.
Potassium oxide,	62.293
Calcium oxide,	15.495
Magnesium oxide,	1.757
Ferric oxide,	1.962
Phosphoric acid,	18.491
	99.998

Cherry Currants.

[From Experimental Plats on College Grounds.]

		Per cent.
Moisture at 100° C.,	87.70	88.46
Dry Matter,	12.30	11.54
Ash,	.46	–
Specific Gravity of Juice at 27° C.,	1.035	–
Sugar (Glucose) in Juice,	–	1.96
Acid (Tartaric) in Juice,	–	5.80

White Currants (*White Grape*).

[From Experimental Plats on College Grounds.]

Moisture at 100° C.,	84.82 per cent.
Dry Matter,	15.18 "
Ash,	.59 "

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	53.81 per cent.
Calcium oxide,	17.46 "
Magnesium oxide,	4.72 "
Ferric oxide,	1.47 "
Phosphoric acid,	22.54 "
	100.00

Raspberries (*Black Caps*).

[From Experimental Plats on College Grounds.]

Crude Ash, .33 to .44 per cent.

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	50.000 per cent.
Calcium oxide,	19.441 "
Magnesium oxide,	9.599 "
Ferric oxide,	.486 "
Total phosphoric acid,	20.474 "
	100.000

Lombard Plum.

[From Experimental Plats on College Grounds.]

Crude Ash, .29 to .35 per cent.

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	76.589 per cent.
Calcium oxide,	13.261 "
Magnesium oxide,	2.165 "
Ferric oxide,	.541 "
Total phosphoric acid,	7.443 "
	99.999

BLACKBERRIES.

[From Experimental Plats on College Grounds.]

Crude Ash,	.35 to .40 per cent.

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	51.424 per cent.
Calcium oxide,	17.222 "
Magnesium oxide,	5.300 "
Ferric oxide,	1.421 "
Phosphoric acid,	24.129 "
	99.999

BLUEBERRIES.

(*Matured.*)

[Collected July 15, 1885, near Amherst, Mass.]

Moisture at 100° C.,	82.69 per cent.
Dry Matter,	17.31 "
Nitrogen (in Dry Matter),	.14 "
(Equal to Albuminoids, 0.875 per cent.)	
Juice,	Mucilagenous.
Acid in Juice (Tartaric),	1.27 per cent.
Sugar in Juice { Glucose,	9.34 "
Sugar in Juice { Cane sugar,	.46 "
Crude Ash (in Dry Matter),	.16 "

One hundred parts of crude ash in dry matter contained 2.04 parts of silicious and earthy material.

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	31 362 per cent.
Calcium oxide,	28.021 "
Magnesium oxide,	9.254 "
Ferric oxide,	2.313 "
Phosphoric acid,	29.049 "
	99.999

OBSERVATIONS ON APPLES.

JUICE AND POMACE.

1. *Material sent on from Cider Mills.*

[From Mixture of Apples.]

OCTOBER 6, 1885.

Juice.

Specific Gravity,	1.045
Temperature,	20° C.
Total Sugar,	7.58 per cent.
Acid (Malic),	1.00 "

Pomace.

Moisture,	81.99
Dry Matter,	18.01
	100 00

OCTOBER 30.

Juice of Sweet Apples.

Specific Gravity,	1.06
Temperature,	13° C.
Total Sugar,	11.74 per cent.
Acid (Malic),	.20 "

Pomace (Sweet Apples).

Moisture,	75.17 to	80.57
Dry Matter,	24.83 to	19.43
	100.00	100.00

Acid (Malic) in original Pomace, .18 per cent.

OCTOBER 30.

Juice of Baldwin Apples.

Specific Gravity,	1.055
Temperature,	15° C.
Total Sugar,	11.16 per cent.
Acid (Malic),	.92 "

Pomace (Baldwin Apples).

Moisture,	82.78 to	83.70
Dry Matter,	17.22 to	16.30
	100.00	100.00

Acid (Malic) in original Pomace, .78 per cent.

POMACE.

[Collected at Mill in Amherst, Mass.]

Moisture,	85.54
Dry Matter,	14.46
	100.00

Acid (Malic) in original Pomace, .31 per cent.

Some of this material has been ensilaged, and will be tested again, at the proper time, later in the season.

2. *Rhode Island Greening.*

[All Obtained from the same tree, at Amherst.]

October 6, 1885.

Juice.

Specific Gravity,	1.045
Temperature,	17.5° C.
Total Sugar,	6.56 per cent.
Acid (Malic),	1.25 "

Pomace.

Moisture,	69.49
Dry Matter,	30.51
	100.00

October 28.

Juice.

Specific Gravity,	1.05
Temperature,	23.5° C.
Total Sugar,	9.44 per cent.
Acid (Malic),	1.01 "

Pomace.

Moisture,	78.95
Dry Matter,	21.05
	100.00

December 2.

Juice.

Specific Gravity,	1.05
Temperature,	22° C.
Total Sugar,	11.58 per cent.
Acid (Malic),	.86 "

Pomace.

Moisture,	78.22
Dry Matter,	21.78
	100.00
Acid (Malic) in original Pomace,	.69 per cent

December 12.

Percentage of Juice pressed out by hand pressure, after grating,	50.43 per cent.
Juice contained Moisture,	83.67 "
" Dry Matter,	16.33 "
	100.00

The juice for the above analyses of Rhode Island Greenings (2) was obtained by means of a hand press.

Apple Juice. — The above stated analyses of the juice — in particular those under the heading (2) Rhode Island Greening — were made to show the influence of the state of maturity of the apples turned to account on the composition of the juice, and consequently on that of the articles manufactured from it, — cider and vinegar.

The apples in the above stated case were all taken from the tree on the same day, Oct. 6, 1885, and part of them wrapped in paper and put into close drawers in a cool room to be kept for later tests. These analytical results coincide with those obtained on a previous occasion.

BALDWIN APPLE.

1877.	Amount of Dry Matter left at 100° to 110° C.	Amount of Moisture left at 100° to 110° C.	Specific Gravity of Juice at 12° to 15° C.	Percentage of Sugar in Juice.
Sept. 1, . .	20.14	79.86	1.055	3.09
Oct. 9, . .	19.66	80.34	1.065	6.25
Nov 27, . .	–	–	1.075	10.42

These three samples were taken from the tree on the day stated, and tested without delay.

RHODE ISLAND GREENING.

1877.	Amount of Dry Matter left at 100° to 110° C.	Amount of Moisture left at 100° to 110° C.	Specific Gravity of Juice at 12° to 15° C.	Percentage of Sugar in Juice.
Sept. 1, . .	20.27	79 73	1.055	3.16
Oct. 9, . .	19.68	80.32	1.066	7.14
Nov. 27, . .	20.25	79.75	1.080	11.36

The first two samples were tested directly after they were taken from the tree. The third, which resembles closely

the second, when taken from the tree, October 9th, was wrapped in a paper and kept in a close box; it was tested November 27th, or about seven weeks after being taken from the tree. A glance at the above results reveals the fact, at once, that the Greening taken from the tree suffered similar changes in its composition as the Baldwin left on the tree.

In the ripening of the grape it has been noticed that there is no gain in the per cent. of sugar after its removal from the vine, except by the evaporation of moisture; while in the apple a very marked increase takes place. This would seem to indicate that the starch, which is always present in the apple, was gradually converted into sugar. (See Abstract of Investigation, Report of Secretary of Massachusetts State Board of Agriculture for 1879-80, p. 365.)

The farther the apples are advanced towards maturity, the more sugar is found in the juice, the more alcohol can be produced subsequently by fermentation, and ultimately the more acetic acid will be obtained in an equally well-managed vinegar factory. The attainable quantity of alcohol in the cider, and of acetic acid in the cider vinegar, stands in a direct relation to the percentage of sugar in the apple juice.

As each variety has its own time for maturing fully, independent of season, much advantage may be gained by assorting the apples before they are sent to the mill, with reference to that condition. Neither half-ripe apples nor much overmatured apples are best for the mill, to secure the most valuable juice they are able to furnish.

Apple Pomace. — The samples of apple pomace described below with reference to their relative fodder value, were obtained in connection with the production of some of the previously reported juice of apples. The fodder analyses of these pomaces are accompanied by fodder analyses of whole apples, in some instances of the same varieties from which the former had been produced, either at our own laboratory by the use of a hand press, or by means of an ordinary cider mill in the vicinity of Amherst.

Fodder Analyses of Apple Pomace.

ANALYSES OF DRY MATTER.	R. I. Greening. Amherst, Oct. 6, 1885.	Baldwin. Prescott, Oct. 6, 1885.
Crude Ash,	1.09	1.82
" Cellulose,	16.58	13.15
" Fat,	3.19	4.37
" Protein (Nitrogenous Matter),	6.94	7.73
Non-nitrogenous Extract Matter,	70.20	72.93
	100.00	100.00

Fodder Analyses of Whole Apple.

ANALYSES OF DRY MATTER.	R. I. Greening. Amherst, Oct. 28, 1885.	Sweet Apple. Prescott, Oct. 28, 885.
Crude Ash,	2.13	2.02
" Cellulose,	7.05	6.14
" Fat,	2.81	1.71
" Protein (Nitrogenous Matter),	4.57	3.92
Non-nitrogenous Extract Matter,	83.44	86.21
	100.00	100.00

The value of apple pomace for feeding purposes depends largely, if otherwise in a good condition, on the amount of dry matter it contains. In our case the latter varied, when fresh from the mill, from 15 to 20 per cent., making 17.5 per cent. the average result.

The same circumstance applies to the determination of the relative fodder value of the whole apple. The amount of dry matter found in the whole apples did not, in our case, differ essentially from that found in the various pomaces.

The pomace is richer in nitrogenous matter than the apple from which it has been produced. The money value of its fodder constituents is usually assumed to be, pound for pound, one-third higher than that of the whole apple which served for its production.

A well-matured apple yields, in a good mill, from 55 to 60 per cent. of juice and from 40 to 45 per cent. of pomace. European authorities (E. Wolff) consider the money value of the fodder constituents contained in good varieties of apples and pears somewhat higher than that contained in an equal weight of turnips; and those of the apple pomace equal to those of sugar beets.

Apples and apple pomace ought to be fed in moderate quantities, similar to those adopted in case of root crops, to secure their full benefit as an efficient ingredient of the daily diet for various kinds of farm live stock. Being deficient, comparatively speaking, in nitrogenous and certain saline constituents, they ought to be liberally supplemented for dairy stock with wheat shorts, bran, oil cakes, clover, good hay, etc.

It has been recommended to sprinkle, in the earlier part of the season, over the crushed, half-matured apple mass, some pulverized chalk, to counteract the action of an excess of free organic acids on the digestive organs.

Some of the pomace has been ensilaged to study the changes in the silo.

The scarcity of reliable analyses of our prominent fruit trees, as well as of parasitic vegetation, which at times appears upon them, may serve as an excuse for closing this chapter with some analyses of C. Erdmann, taken from his dissertation, "The Inorganic Constituents of Plants": Göttingen, 1855.

Analysis of Apple-tree (Wood).

[Collected in the beginning of June.]

	Per cent.
Potassium oxide,	3.461
Sodium oxide,	1.836
Calcium oxide,	57.070
Magnesium oxide,	2.827
Phosphate of iron,	1.400

	Per cent.
Phosphoric acid,	3.210
Sulphuric acid,	1.000
Silicic acid,	1 810
Chlorine,	.420
Carbonic acid,	24.300
Loss (carbon, etc.),	2.672
	100.000

Analyses of Mistletoe (Viscum album).

[Taken, in the beginning of June, from an apple-tree.]

The specimens which served for the following analyses were collected at the same time when the wood of the apple-tree upon which they had grown was secured for the preceding analysis.

Moisture in stems,	56.68 per cent.
Moisture in leaves,	62.52 "
Ash constituents in stems,	1.90 "
Ash constituents in leaves,	3.85 "

One hundred parts of the ash constituents contained: —

	Leaves.	Stems.
Potassium oxide,	19.736	20.153
Sodium oxide,	4.327	4.127
Calcium oxide,	22.600	22.176
Magnesium oxide,	9.335	9.750
Phosphate of iron,	1.580	1.640
Phosphoric acid,	16.370	16.276
Sulphuric acid,	1 250	1.050
Silicic acid,	2.053	2.045
Chlorine,	.864	.815
Carbonic acid,	16.800	15.720
Loss (carbon, etc.),	6.786	6.048
	100.000	100.000

A comparison of the ash constituents of the leaves and of the stems of the mistletoe shows but a very slight difference; whilst those of both, compared with those of the apple wood they had grown on, show a marked difference in potassa, lime, phosphoric acid and magnesia. The ash of the parasite contains six times more potassa, five times more phosphoric acid, and four times more magnesia than that of the wood of the apple-tree; the latter, on the other hand, contains two and one-half times more lime than the former.

A serious influence of the growth of the parasite on the normal condition of the tree can scarcely be doubted.

Cranberry.

The specimens of the cranberry which served for this test were furnished by parties engaged in their growth and desiring to know the relative proportion of the essential elements of plant food, for the purpose of determining what to return to the soil.

The analysis is republished in consequence of frequent inquiries.

The following tables give the analyses of the fruit two weeks after harvesting. One hundred air-dry weight parts contained: —

	1877.	1878.
Moisture lost at 100° to 110° C., ...	89.290	89.890
Dry Matter, ...	10.710	10.110
Ash Constituents in Dry Matter, ...	–	.179
Nitrogen in Dry Matter, ...	–	.160
Specific Gravity of Juice at 15° C., . . .	1.025	1.025
Grape Sugar in Juice, ...	1.350	1.700
Free Acid in Juice, ...	2.250	2.430

No cane sugar was found; the acid, probably, was of two kinds, — citric acid or the acid of the lemon, and malic acid or that of the apple.

The dried ash of the cranberries collected in 1877 contained: —

Potassium oxide,	47.96 per cent.
Sodium oxide,	6.58 "
Calcium oxide,	18.58 "
Magnesium oxide,	6 78 "
Ferric oxide,	.66 "
Phosphoric acid,	14.27 "
Silicic acid and trace of sand,	5.22 "

Rhubarb.

	Stems and Leaves. Fresh.	Roots. Fresh.
Moisture at 100° C.,	91.67 per cent.	74.35 per cent.
Dry Matter,	8.33 "	25.65 "
Nitrogen (in Dry Matter),	.13 "	.55 "
Crude Ash (in Dry Matter),	1.72 "	2.28 "
Insoluble Matter in Ash,	.22 "	.25 "
Potassium oxide,	.36 "	.53 "
Sodium oxide,	.03 "	Not determined.
Calcium oxide,	.34 "	.50 per cent.
Magnesium oxide,	.13 "	.16 "
Phosphoric acid,	.02 "	.06 "
Ferric oxide,	.003 "	.02 "

Relative proportion of the essential ash constituents, soluble in acids: —

Potassium oxide,	41.37 per cent.	37 92 per cent.
Sodium oxide,	3.39 "	8.84 "
Calcium oxide,	38.62 "	35.95 "
Magnesium oxide,	14.50 "	11.40 "
Phosphoric acid,	1.80 "	4.32 "
Ferric oxide,	.32 "	1.57 "

The analysis has been carried out at the request of garden farmers in the eastern part of the State. The sample was collected from the fields of the college at the time when the plant was blooming. The results may give some more definite basis for an advantageous mode of manuring.

Horse Radish.

(Cochlearia Armovacia L.; Mustard, Family, — Cruciferæ.)

The examination of this well-known garden plant was carried on at the request of a farmer in Franklin County, who is

engaged in the preparation of horse radish, with vinegar, for family use. The roots had evidently lost some of their original moisture by storing, at the time of their examination.

One hundred parts of the fresh roots contained: —

Moisture at 100° C.,	76.68 per cent.
Dry Matter,	23.32 "
Nitrogen in Dry Matter,	.36 "
Sulphur in Dry Matter,	.06 "
Crude Ash in Dry Matter,	1.87 "

The crude ash — 1.87 — consisted of 0.71 parts of insoluble silicious matter (including, most likely, some soil), and of 1.16 parts of soluble mineral constituents of plant food.

Relative proportion of essential ash constituents, soluble in acids, sulphur and chlorine excluded: —

Magnesium oxide,	8.24 per cent.
Ferric oxide,	2.13 "
Calcium oxide,	13.47 "
Sodium oxide,	10.29 "
Potassium oxide,	62.06 "
Phosphoric acid,	3.81 "
	100.00

The roots contain, besides a notable amount of nitrogenous constituents, a series of valuable non-nitrogenous substances, as starch, sugar, gum, and organic acids, — a circumstance which cannot fail to impart to them a considerable nutritive value, equal, if not superior, to several of our most valuable root crops. Their peculiarity consists, mainly, in the presence of some sulphur-containing organic constituents (myrosin, etc.), which cause, in the fresh and crushed roots, the production of a sulphur-containing, volatile compound. The latter resembles, in odor and taste, the volatile mustard oil (*Rhodanallyl*). Some investigators assume their identity. The amount of this product, according to the statement of good observers, depends largely, either on the general character of the soil, or on the presence of some peculiar constituent in the latter. It would be not without interest to study the effect of gypsum, or of sulphate of potash, as a special fertilizer, on the character of the roots raised in their presence.

ANALYSES OF FODDER AND FOOD.

HAMPDEN PROLIFIC CORN.

[Sent on for examination from Springfield, Mass.]

The ears contained from eighteen to twenty rows of kernels, were of a whitish color, and had an average length of from $9\frac{3}{4}$ to 10 inches. They consisted in weight of from 86.5 to 88.2 per cent. of kernels, and from 21.8 to 23.5 per cent. of cobs. The average weight of the ears sent on, varied from 473.4 to 491.4 grames (about 1 lb.); that of a single kernel, from .39 to .43 grames. The moisture amounted to from 8.02 to 11.43 per cent.

No. 1 was raised upon a sandy loam, in good condition.

No. 2 was raised upon a heavy soil, in good condition, according to statements made.

	No. 1.	No. 2.
Moisture of kernels,	11.43	8 02
Dry Matter,	88.57	91.98
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	1.72	1.69
" Cellulose,	2.17	1.98
" Fat,	4.52	5.29
" Protein (Nitrogenous Matter),	11.36	13.73
Non-nitrogenous Extract Matter,	80.23	77.31
	100.00	100.00

The analysis of this variety of corn furnishes an additional illustration of the influence of fitness and condition of soil on the composition of one and the same kind of crop, under similar climatical conditions. The corn No. 2 contains nearly one-fifth, or 20 per cent., more fat and nitrogenous compounds — the most costly constituents — than sample No. 1. A comparison of the above stated analytical results, with the analyses of prominent varieties of corn raised within the State, shows that, as far as composition is concerned, the Hampden Prolific Corn may be counted of equal value with our home standard articles. For details I refer to an article "On Relative Value of Several Prominent Varieties of Eastern, Western and Southern Corn," published in the annual report of the secretary of the Massachusetts State Board of Agriculture for 1879, pages 221–250.

To manure our farm crops well pays, as a rule, not less in regard to the improvement in quality than in the increase of quantity.

I. BLUE JOINT GRASS HAY.

(CALAMAGROSTIS CANADENSIS.)

[From the lands along the Ipswich River; for the Essex County Agricultural Society.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.90	118.00	–	–	
Dry Matter,	94.10	1,882.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.20	124.00	–	–	
" Cellulose,	28.91	578.20	335.36	58	
" Fat,	2.54	50.80	23.37	46	1 : 13.08
" Protein (Nitrogenous " Matter),	7.29	145.80	83.11	57	
Non-nitrogenous Extract Matter,	55.06	1,101.20	693.76	63	
	100.00	2,000.00	1,135.60	–	

The grass had been cut in the first week in August. The hay sent on consisted in the main of blue joint grass, yet contained, besides, a variety of other plants found in similar localities, as *juncus*, *cyperus*, etc. Its composition is similar to that of several samples of hay obtained from the low marsh meadows, sent on by the Rowley Farmers' Club. (See First Annual Report, 1883, pp. 74 and 75.)

II. BUNKER MEADOW HAY.

[Sent on by the Secretary of the Essex County Agricultural Society.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.35	227.00	–	–	
Dry Matter,	88.65	1,773.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.40	128.00	–	–	
" Cellulose,	30.71	614.20	208.83	34	1 : 9.91
" Fat,	2.29	45.80	34.81	76	
" Protein (Nitrogenous Matter),	7.66	153.20	130.22	85	
Non-nitrogenous Extract Matter,	52.94	1,058.80	995.27	94	
	100.00	2,000.00	1,369.13	–	

III. HIGH MEADOW HAY.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.60	212.00	–	–	
Dry Matter,	89.40	1,788.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.58	151.60	–	–	
" Cellulose,	27.23	544.60	185.16	34	1 : 8.12
" Fat,	2.77	55.40	42.10	76	
" Protein (Nitrogenous Matter),	9.33	186.60	158.61	85	
Non-nitrogenous Extract Matter,	53.09	1,061.80	998.09	94	
	100.00	2,000.00	1,383.96	–	

The above described samples of hay, I., II. and III., have been examined by the direction of the Secretary of the Essex County Agricultural Society, for farmers in Topsfield, Mass. The hay had been obtained from meadows in the vicinity of the Ipswich River. No. III. is the most nutritious material, and No. II. has a larger amount of digestible matter than No. I.

CORN MEAL.

[93.28 per cent. passed through mesh 144 to square inch. Bought of J. L. Holley, South Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.95	239.00	–	–	
Dry Matter,	88.05	1,761.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.59	31.80	–	–	
" Cellulose,	2.59	51.80	17.61	34	1 : 7.42
" Fat,	4.43	88 60	67.34	76	
" Protein (Nitrogenous Matter),	13.13	262.60	223.21	85	
Non-nitrogenous Extract Matter,	78.26	1,565.20	1,471.29	94	
	100.00	2,000.00	1,779.45	–	

HOMINY MEAL.

[Sent on for examination from Bolton, Mass. 70.56 per cent. passed through mesh 144 to square inch.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.11	162.20	–	–	
Dry Matter,	91.89	1,837.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	3.24	64.80	–	–	
" Cellulose,	4.78	95.60	32.50	34	1 : 9.28
" Fat,	12.22	244.40	185.74	76	
" Protein (Nitrogenous Matter),	11.76	235.20	199.92	85	
Non-nitrogenous Extract Matter,	68.00	1,360.00	1,278.40	94	
	100.00	2,000.00	1,696.56	–	

The article was of a good mechanical condition, and its composition notable on account of the exceptional high percentage of fat. The statement concerning its digestibility is based on that of corn, as no actual trials in that direction are known to us.

MIDDLINGS.

[Sent on by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.25	185.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	1 : 4.74 to 1 : 5.
Dry Matter,	90.75	1,815.00			
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude Ash,	5.34	106.80			
" Cellulose,	8.40	168.00			
" Fat,	6.46	129.20			
" Protein (Nitrogenous Matter),	18.18	363.60			
Non-nitrogenous Extract Matter,	61.62	1,232.40			
	100.00	2,000.00			

The article is rich in valuable constituents for feeding purposes, and compares favorably with those of its kind. It seems quite safe to assume the rates of digestibility noticed in wheat bran, fed to cattle, which have been repeatedly stated in the bulletins. (See No. 11, page 5.)

Analysis of Sugarhouse Molasses.

[From Grange Store, Amherst, Mass.]

(SUGAR CANE.)

Moisture at 100° C.,	22.98 per cent.
Dry matter,	77.02 "
Total sugar,	66.11 "
Glucose,	16.98 "
Sucrose,	49.13 "
Magnesium oxide,	.19 "
Calcium oxide,	.28 "

VALUATION OF FERTILIZERS, AND FERTILIZER ANALYSES.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	Cents per Pound.	
	1884.	1885.
Nitrogen in ammonia,	22	18
Nitrogen in nitrates,	18	18
Nitrogen in dried and fine ground fish,	20	18
Organic nitrogen in guano and fine ground blood and meat,	18	18
Organic nitrogen in cotton seed, linseed meal, and in castor pomace,	18	18
Organic nitrogen in fine ground bone,	18	18
Organic nitrogen in fine medium bone,	16	16
Organic nitrogen in medium bone,	14	14
Organic nitrogen in coarse medium bone,	12	12
Organic nitrogen in coarse bone, horn shavings, hair, and fish scraps,	10	10
Phosphoric acid, soluble in water,	10	9
Phosphoric acid, soluble in ammonia citrate,*	9	8
Phosphoric acid, insoluble in dry fine ground fish, and in fine bone,	6	6
Phosphoric acid, insoluble in fine medium bone,	5½	5½
Phosphoric acid, insoluble in medium bone,	5	5
Phosphoric acid, insoluble in coarse medium bone,	4½	4½
Phosphoric acid in coarse bone,	4	4
Phosphoric acid in fine ground rock phosphate,	2¼	2
Potash as high grade sulphate,	7¼	7¼
Potash as kainite,	4¼	4¼
Potash as muriate,	4¼	4¼

* Dissolved from two grams of phosphate, unground, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in 30 minutes at 65 deg. C., with agitation once in five minutes; commonly called "reverted" or "backgone" phosphoric acid.

The above trade values are the figures at which, on March 1st, the respective ingredients could be bought at retail for cash in our markets in the *raw materials*, which are the regular source of supply.

They also correspond, as has been stated, to the average wholesale prices for the six months ending March 1st, plus 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures, will be found to agree fairly with the reasonable retail price in case of standard raw materials, such as, —

Sulphate of Ammonia,	Azotin,
Nitrate of Soda,	Dry Ground Fish,
Muriate of Potash,	Cotton Seed,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone,

Plain Superphosphates.

Wood Ashes.

[I., II. Ashes sent on from Beverly, Mass.]
[III. Canada ashes, sent on by the Secretary of the Greenfield Farmers' Club.]
[IV. Sent on for examination from Chicopee, Mass.]

	Pounds per Hundred.			
	I.	II.	III.	IV.
Moisture at 100° C., . . .	8.80	14.40	12.93	15.73
Potassium oxide, ...	2.18	2.25	5.50	5.93
Calcium oxide, ...	45.90	34.33	33.99	35.45
Magnesium oxide, . . .	3.63	3.13	4.22	3.41
Phosphoric acid, ...	2.22	1.79	2.05	1.60
Insoluble matter, ...	8.86	14.40	10.42	10.29

Samples I. and II. are apparently partly leached; samples III. and IV. are of a fair average composition.

Canada Wood Ashes.

[I. E. McGarvey. Collected of Edward Swan, South Deerfield, Mass.]
[II. Munroe, Judson & Stroup, Oswego, N. Y. Collected of Walter Crafts & Son Whately, Mass.]
[III. Sent on for examination from Montague, Mass.]

	Pounds per Hundred.		
	I.	II.	III.
Moisture at 100° C,	16.55	11.95	6.75
Calcium oxide,	34.42	39.60	34.71
Magnesium oxide,	2.52	2.28	2.45
Potassium oxide,	5.36	6.46	6.30
Phosphoric acid,	2.06	1.77	2.21
Insoluble matter,	24.10	10.12	16.10

These samples are of good composition; they are sold at 25 cents per bushel on board of cars. The bushel averages from 45 to 48 pounds.

Canada Ashes.

[I. Collected of Wm. H. Earle & Co., Worcester, Mass.]
[II. Munroe, Judson & Stroup. Collected of Albert Montague, South Deerfield, Mass.]
[III. Munroe, Judson & Stroup. Collected of E. M. Roche, South Deerfield, Mass.]

	Pounds per Hundred.		
	I.	II.	III.
Moisture at 100° C.,	3.30	11.25	13.33
Total phosphoric acid,	2.30	1.09	1.28
Potassium oxide,	8.51	6.36	5.91
Calcium oxide,	37.49	37.62	39.21
Magnesium oxide,	3.93	7.47	5.11
Insoluble matter,	11.60	6.37	9.36

Sample I. sold at $14.25 per ton, counting 45 pounds the weight of a bushel, at 33 cents per bushel. Samples II. and III. sold at 25 cents per bushel, of from 45 to 48 pounds each.

Ash of Spent Tan Bark.

[Sent on for examination from North Adams, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	7.75	–
Calcium oxide,	31.78	31.35
Magnesium oxide,	2.57	5.10
Potassium oxide,	1.14	2.87
Phosphoric acid,	2.77	1.92

The article resembles leached wood ash, as might be expected from the previous treatment of the hemlock bark.

Potash Salts.

[Sent on by the Secretary of the Dartmouth Farmers' Club.]

[I. Potash Salts, a fused hard mass, of a clayish-white color.]

[II. Black or Blue Ash, a moist, lumpy mass, easily pulverized.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	1.08	14.60
Potassium oxide,	42.06	13.13
Sodium oxide,	24.51	4.51
Chlorine,	19.30	.08
Sulphuric acid,	1.38	7.90
Insoluble matter,	1.00	3.30

These articles are evidently waste materials from some potash industry. No. I. represents a value of from $36 to $37 per ton; it contains some potassium sulphide, and ought to be exposed to the air, previous to its application, to prevent injurious influences on the young growth. No. II. contains a considerable amount of carbonates, and is better fitted for direct use as a potash source; it is worth from $11 to $12 per ton.

Muriate of Potash.

[Sent on for examination by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Per cent.
Moisture at 100° C.,	.63
Potassium oxide,	51.33
Valuation per ton, at current rates,	$43 63

Muriate of Potash.

[Used at Experiment Station, 1885.]

	Per cent.
Moisture at 100° C.,	.47
Potassium oxide,	49.80
Valuation per 2,000 lbs.,	$42 33

Potash Salts.

[I. Muriate of potash, sent on from Fall River, Mass.]
[II. Muriate of potash, from H. L. Phelps, Southampton, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	2.00	1.50
Potassium oxide,	52.00	51.28
Sodium oxide,	–	8.04
Insoluble matter,	–	2.00
Valuation for 2,000 lbs.,	$44 20	$43 59

Muriate of Potash.

[Collected in Worcester, Mass.]

	Per cent.
Moisture at 100° C.,	1.63
Potassium oxide,	53.68
Insoluble matter,	.15
Valuation per 2,000 lbs.,	$45 63

Sulphate of Potash.

[Sent on from New York City.]

	Per cent.
Moisture at 100° C.,	.35
Potassium oxide,	47.60
Sulphuric acid,	44.83
Insoluble matter,	.67
Valuation per 2,000 lbs.,	$69 02

[I. Double Sulphate of Potash and Magnesia, sent on for examination.]
[II. Double Sulphate of Potash and Magnesia, sent on from Hatfield, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	1.95	2.73
Potassium oxide,	23.37	18.92
Magnesium oxide,	12.86	13.08
Calcium oxide,	3.38	3.97
Sodium oxide,	Not determined.	9.61
Sulphuric acid,	45.52	41.89
Chlorine,	1.36	7.80
Insoluble matter,	2.10	2.36

The samples represent, probably, the extremes in composition. Large percentages of chlorides are, in many instances, considered objectionable, in high-priced sulphates. The articles have been offered at from $38 to $40 per ton.

Krugit.

[Bowker Fertilizer Co., Boston, Mass.]

	Per cent.
Moisture at 100° C.,	4.82
Sodium oxide,	5.57
Potassium oxide,	8.42
Calcium oxide,	12.45
Magnesium oxide,	8.79
Sulphuric acid,	31.94
Chlorine,	6.63
Insoluble matter (in acids),	14.96

This saline belongs to the products of the "German Potash Industry" at Strassfurt. It contains from 15 to 16 per cent. of sulphate of potassa, besides sulphate of lime (gypsum), sulphate of magnesia, and chloride of sodium (common salt), etc. A careful trial of the article upon hill pastures, as a top-dressing, in connection with fine ground bones, deserves attention. It sold at $14 per ton of 2,000 pounds, on board of cars in Boston.

Lime Kiln Ashes.

[Collected at Holyoke, Mass.]

	Per cent.
Moisture at 100° C.,	30.70
Calcium oxide,	37.55
Magnesium oxide,	3.68
Potassium oxide,	1.70
Phosphoric acid,	1.27
Carbonic acid,	17.83
Insoluble matter,	3 30

Sold at 22 cents per bushel.

The material is a fair sample of its kind.

Refuse Lime.

[Sent on for examination from Lowell, Mass.]

	Per cent.
Moisture at 100° C.,	33.54
Phosphoric acid,	1.62
Magnesium oxide,	8.30
Calcium oxide,	40.57
Insoluble matter,	.40

The lime consists of a mixture of calcium oxide and carbonate of lime, and is equal in pecuniary value to air-slacked lime.

Plaster.

[I. Ground Nova Scotia plaster. Collected of B. F. Bridges, South Deerfield, Mass. Sold at $7.50 per ton.]
[II. Onondaga plaster. Collected of B. F. Bridges, South Deerfield, Mass Sold at $6 per ton.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	4.07	8.95
Calcium oxide,	33.59	29.60
Sulphuric acid,	47.23	32.68
Insoluble matter,	–	8.95

Cayuga Land Plaster.

[Sent on for examination.]

	Per cent.
Moisture at 100° C.,	11.56
Calcium oxide,	29.35
Magnesium oxide,	4.76
Sulphuric acid,	32.76
Carbonic acid,	7.20
Insoluble matter,	12.00

Sold at $6 per ton.

Boneblack Waste.

[I. Sent on by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]
[II. Sent on for examination from Concord, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	2.30	6.00
Total phosphoric acid,	30.20	27.36
Insoluble matter,	1.53	6.60

four cents per pound of phosphoric acid for boneblack of a fine mechanical condition, Sample I. represents a value of from $23 to $24, and Sample II. of from

$21 to $22 per ton of 2,000 pounds. The valuation of these articles depends somewhat on their mechanical condition. They furnish a superior material for the manufacture of superphosphate of lime.

Dissolved Boneblack.

[Sent on for examination by Bolton Farmers' and Mechanics' Association, Bolton Mass.]

	Per cent.
Moisture at 100° C.,	10.05
Total phosphoric acid,	17.56
Soluble " "	16.84
Reverted " "	.44
Insoluble " "	.28
Insoluble matter,	1 08
Valuation per 2,000 lbs.,	$31 24

Dissolved Boneblack.

[Used at Experiment Station, 1885.]

	Per cent.
Moisture at 100° C.,	11.73
Total phosphoric acid,	17.34
Soluble " "	16.64
Reverted " "	.44
Insoluble " "	.26
Insoluble matter,	11.98
Valuation per 2,000 lbs.,	$30 86

Fine Ground Bones.

[Sent on for examination from Hingham, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	4.05	3.65
Total phosphoric acid,	23.77	26.37
Reverted " "	13.65	16.78
Insoluble " "	10.12	9.59
Nitrogen,	3.70	2.90
Insoluble matter,	1.50	2.65
Valuation per 2,000 lbs.,	$43 27	$44 96

The valuation of ground bones varies somewhat, on account of differences in their mechanical condition. The majority of these articles are at present of a very advantageous form.

Swift Sure Bone Meal.

[Used at Experiment Station, 1885.]

	Per cent.
Moisture at 100° C.,	5.60
Total phosphoric acid,	20.36
Soluble " "	-
Reverted " "	6.63
Insoluble " "	13.73
Nitrogen,	6.75
Insoluble matter,	.48
Valuation per 2,000 lbs.,	$43.89

Home-made Superphosphate.

[Sent on for examination from Marblehead, Mass.]

	Per cent.
Moisture at 100° C.,	26.03
Total phosphoric acid,	12.78
Soluble " "	10.87
Reverted " "	.59
Insoluble " "	1.32
Insoluble matter,	16.04
Valuation per 2,000 lbs.,	$21 04

The article was obtained, according to a communication received, by treating one thousand pounds of fine-ground South Carolina rock phosphate with six hundred pounds of sulphuric acid of 66° B. specific gravity, diluted previously with an equal volume of water. As the mixture thus produced remains for some time more moist than desirable, it is recommended to use equal *weights* of *acid* and *water*.

Fertilizing Material.

[Sent on for examination by Farmers' Club. Lanesborough, Mass. No guarantee obtained.]

	Per cent.
Moisture at 100° C.,	10.59
Total phosphoric acid,	12.06
Soluble " "	6.78
Reverted " "	3.34
Insoluble " "	1.94

	Per cent.
Potassium oxide,	.82
Nitrogen,	3.13
Insoluble matter,	4.28
Valuation per 2,000 lbs.,	$31 06

Complete Fertilizer.

[Sent on for examination by Farmers near Worcester, Mass.]

	Per cent.
Moisture at 100° C.,	7.15
Total phosphoric acid,	14.00
Soluble " "	11.26
Reverted " "	2.38
Insoluble " "	.36
Potassium oxide,	1.13
Nitrogen,	2.56
Insoluble matter,	.83
Valuation per 2,000 lbs.,	$34 55

Fertilizing Materials.

[Sent on from Boston, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	4.10	6.24
Phosphoric acid,	1.77	.48
Potassium oxide,	1.35	.40
Nitrogen,	1.33	.57
Calcium oxide,	11.44	18.84
Magnesium oxide,	1.36	1.23
Insoluble matter,	48.35	43.53

The materials are evidently mixtures of refuse from various sources, and contain large quantities of insoluble matter. No. I. is worth from $7 to $8 per ton, and No. II. from $2.50 to $3.

Fish Waste.

[Sent on from the Secretary of Hampshire, Franklin and Hampden Society.]

	Per cent.
Moisture at 100° C.,	41.92
Total phosphoric acid,	5.20
Soluble " "	.83
Reverted " "	2.02
Insoluble " "	2.35
Nitrogen,	7.60
Insoluble matter,	.28
Valuation per 2,000 lbs,	$34.37

Ammonite.

[Sent on by Secretary of Hatfield Grange.]

Guaranteed composition: Ammonia, 15 to 16 per cent. (equivalent to nitrogen, 12.4 to 13.2 per cent.); phosphoric acid, 4 to 6 per cent.

	Per cent.
Moisture at 100° C.,	5.88
Total phosphoric acid,	3.43
Nitrogen (=ammonia, 13.76 per cent.),	11.33
Insoluble matter,	1.38
Valuation per 2,000 lbs.,	$14.90

The article consists, evidently, of fine-ground animal matter, freed from fat. Its general physical character is apparently favorable to a speedy disintegration. The material deserves attention as a source of nitrogen for plant growth.

Dried Blood.

[Sent on for examination by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Per cent.
Moisture at 100° C.,	7.65
Nitrogen,	8.10
Phosphoric acid,	6 23
Insoluble matter,	1.08
Valuation per 2,000 lbs.,	$36.64

Dried Blood.

[Used at Experiment Station, 1885.]

	Per cent.
Moisture at 100° C.,	16.10
Nitrogen,	12.49
Valuation per 2,000 lbs.,	$44.96

Nitrate of Soda.

[Sent on for examination by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Per cent.
Moisture at 100° C.,	.85
Nitrogen,	16.26
Valuation per 2,000 lbs.,	$58.54

Saltpetre Waste.

[Sent on from Acton, Mass]

	Per cent.
Moisture at 100° C.,	.50
Sodium oxide,	44.93
Potassium oxide (largely chloride),	4.65
Nitrogen (in nitrates),	1.87

The sample represents a trade value of from $10 to $11 per ton, and will prove quite effective upon grass lands and in case of forage crops in general.

Ammonium Sulphate.

[Sent on for examination by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Per cent.
Moisture at 100° C.,	.25
Nitrogen,	21.28
Valuation per 2,000 lbs.,	$76.60

Ammonium Sulphate.

[Used at Experiment Station, 1885.]

	Per cent.
Nitrogen,	20.35
Valuation per 2,000 lbs.,	$73.26

Cotton-seed Meal (Coarse).

	Per cent.
Moisture at 100° C.,	6.80
Organic and volatile matter,	94.23
Ash constituents,	5.77
Phosphoric acid,	1.45
Potassium oxide,	.89
Calcium oxide,	.39
Magnesium oxide,	.99
Nitrogen,	6.10
Insoluble matter,	.60
Valuation per 2,000 lbs.,	$24.46

Material taken from a Ditch in a Diked Marsh at East Salisbury, Mass.

[Sent on for examination.]

	Per cent.
Moisture at 100° C.,	33.40
Organic and volatile matter,	92.15
Ash,	7.85
Ash soluble,	4.20
Ash insoluble,	3.65
Nitrogen (in organic matter),	1.64
Phosphoric acid,	.13
Potassium oxide,	.26
Calcium oxide,	1.24

This material is quite rich in manurial substances, and is equal, in that respect, to the better quality of peat.

Muck.

[Three Samples of Muck sent on for examination from Goshen, Mass.]

	Pounds per Hundred.		
	I.	II.	III.
Moisture at 100° C.,	63.75	66.80	43.18
Dry Matter,	36.25	33.20	56.82
Ash,	17.30	8.55	26.12
Nitrogen in organic matter,	.75	1.09	.97

Sample No. I. consisted of a solid, unbroken, turfy mass, with but little change in the original vegetable structure. It contained some lime, with traces of phosphoric acid, as more noteworthy mineral constituents. The nitrogen of the vegetable matter is that of a fair quality of its kind, considering the total amount of earthy material present.

Sample No. II. consisted of a black-brown, somewhat pulverulent mass, with rootlets here and there interspersed; it contained more lime and phosphoric acid than No. I., but less earthy matter. The smaller percentage of mineral matter accounts sufficiently for an increased amount of nitrogen as compared with No. I.

Sample No. III. consisted mainly of a material similar to

No. II., covered largely with a grayish saline mass, of an acid and astringent taste. Treated with water, at an ordinary temperature, a very acid solution was obtained, which contained a liberal amount of free sulphuric acid, besides a considerable quantity of the combination of this acid with lime (gypsum), and with oxide of iron (green copperas). The presence of these compounds was evidently due to the action of air and of moisture on iron pyrites, — a combination of sulphur and iron, — contained in the rocks and the soils through which the water percolated which fills the muck-bed.

Wells located in rocks containing iron pyrites are apt to show a similar alteration in their character during the earlier part of the spring, after a dry summer and autumn, when, in consequence of a lower level of the water supply, a more extensive exposure of adjoining rocks has favored the oxidation of both iron and sulphur. This change may assume such proportions at times, that the water of these wells will curdle fresh milk, and produce a more or less ink-like abstract of green tea.

A repeated pumping-out, in most instances, removes the cause of these reactions. An actual observation in this direction at Amherst, a few years ago, after several years of dry seasons, furnished a striking illustration of the previous statement.

A muck like No. III. is decidedly injurious to vegetation, and needs an exceptionally large addition of lime or ashes, and a longer exposure to the air than the average material of this kind, to prepare it for manurial purposes.

Sumac.

[Waste material from Tanneries in Peabody, Mass. Sent on by the Massachusetts Society for Promoting Agriculture.]

	Per cent.
Moisture at 100° C.,	63.06
Organic matter,	36.94
Nitrogen in organic matter,	1.19
Crude ash in organic matter,	6.80
Calcium oxide in ash,	1.14
Magnesium oxide in ash,	3.25
Potassium oxide in ash,	.17
Phosphoric acid,	.17
Insoluble matter in ash,	2.25

The nitrogen, potash and phosphoric acid contained in the above article represent a commercial value of $3.50 to $4 per ton of 2,000 pounds. The tanning principle was so completely abstracted that a composting with some air-slacked lime promises to render the material quite valuable as a manurial substance for light soils, deficient in organic matter.

Kentucky Tobacco Stems, Ground.

[Sent on for examination.]

	Per cent.
Moisture at 100° C.,	12.180
Dry matter,	87.820
Nitrogen (in organic matter),	2.616
Potassium oxide,	8.816
Magnesium oxide,	1.395
Calcium oxide,	3.720
Phosphoric acid,	.726

This article is valuable for fertilizing purposes, and deserves the special attention of tobacco-growers. Its trade value of fertilizing constituents amounts to from $15.50 to $16 per ton of 2,000 pounds, at current rates of valuation.

Analyses of Cotton Waste.

[Sent on from Bedford, Mass.]

	Pounds per Hundred.	
	Wet.	Dry.
Moisture at 100° C.,	34.69	5.53
Phosphoric acid,	1.54	.84
Magnesium oxide,	1.13	.87
Calcium oxide,	2.45	1.45
Potassium oxide,	.80	.89
Nitrogen,	1.30	1.32
Insoluble matter,	41.33	49.68
	$7.21	$6.52

Ash of Corn Cobs.

[Republished at request.]

	Per cent.
Moisture at 100° C.,	10.0000
Ash (average of seven analyses),	.9845

One hundred parts of crude cob ash, dissolved in hydrochloric acid, contained the following elements in the stated proportions: —

	Wheeler's Prolific.	Southern Corn.	Canada Corn.	Western (Yellow) Dent Corn.	Longfellow Corn.
Silica, soluble in soda,	17.344	20.819	10.314	25.478	18.740
Ferric oxide,	trace.	1.249	6.687	.621	1.160
Calcium oxide,	2.189	3.066	2.372	2.293	2.610
Magnesium oxide,	5.317	4.561	4.989	3.976	3.220
Potassium oxide,	60.129	59.818	62.362	54.231	65.890
Sodium oxide,	5.745	2.293	2.907	8.302	2.940
Phosphoric acid,	9.185	8.026	10.363	5.098	5.440

The samples which served for the above analyses were raised under varying conditions; one being obtained from South Carolina, another from Illinois, and the remaining three from this vicinity. The sample of Canada Corn shows the result of high fertilization. For further details, see "Analyses of Different Varieties of Corn," in Report of Secretary Massachusetts Agricultural Society, 1879–80, page 238.

Analysis of Wheat Bran, with reference to its Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	7.18
Phosphoric acid,	2.46
Calcium oxide,	.26
Magnesium oxide,	.89
Sodium oxide,	.37
Potassium oxide,	1.95
Nitrogen (in dry matter),	2.86
Insoluble matter,	.14
Valuation per 2,000 lbs.,	$14.91

Analyses of Drinking Water.

[Composition of One Million Parts.]

NUMBER OF SAMPLE.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids.	Hardness (Clark's degrees).
I., ...	0.06	0.35	3.60	270.0	3.90
II., ...	0.03	0.07	2.25	130.0	–
III., ...	0.06	0.36	22.00	–	–
IV., ...	0.01	0.13	–	35.0	–
V., ...	0.02	0.17	0.40	80.0	–
VI., ...	0.20	0.20	15.70	39.0	0.30
VII., ...	0.01	0.34	–	–	–
VIII., . . .	0.04	0.25	–	46.5	1.11
IX., ...	0.01	0.05	–	52.0	1.43
X., ...	0.06	0.16	18.00	230.0	7.71
XI., ...	0.05	0.14	–	44.0	2.47
XII., ...	0.07	0.14	–	128.0	6.71
XIII., . . .	0.05	0.15	8.00	65.0	2.21
XIV., . . .	1.02	0.35	8.00	94.0	2.60
XV., ...	0.06	0.11	9.90	88.0	2.47
XVI., . . .	0.27	0.27	42.00	222.0	7.43
XVII., . . .	0.05	0.15	11.00	76.0	–
XVIII., . . .	0.02	0.08	17.00	204.0	6.57
XIX., . . .	0.21	0.17	12.00	96.0	1.82
XX., ...	0.08	0.18	13.00	70.0	1.11
XXI., . . .	0.03	0.08	17.00	160.0	4.86

These analyses were made in accordance with requests received from all parts of the State.

METEOROLOGY.

The regular meteorological observations, commenced at the Station in 1884, have been carried out as proposed during 1885. Their plan comprises the general routine recommended to the voluntary observers of the United States Signal Service; viz., tri-daily observations upon temperature, relative humidity, precipitation and general condition of the sky.

The records given here are the results of the first year's observations made at the Station. They have a direct value in connection with the Station work, as furnishing additional data bearing on the field experiments; and, beyond this, contribute something to the mass of meteorological records sought for by the Signal Service. In the latter connection, monthly reports of observations have been rendered to the Chief Signal Officer. Copies of the records have also been contributed to the New England Meteorological Society at the close of each month, and published in its bulletin.

The daily "Farmers' Bulletin," issued by the Signal Service, was received by the Station until its publication was discontinued in July. A valuable feature of these bulletins was the cold wave predictions, which were indicated at the Station by the display of the appropriate signal, — a white flag with black center. This warning was hoisted seven times in the months of January, February and March, and in every case was justified by a marked fall in temperature during the succeeding twenty-four hours. The meaning of the signal was beginning to be understood; and, could such warnings have been given in the fall months, the season of their greatest importance, their value would have been

unquestionable. Daily weather signals are now displayed in most of the large towns and cities of the State. The system entails a trifling expense, and it seems desirable that the Station should participate in an undertaking of such unquestionable importance to the agricultural community. There are critical periods in all farm operations, when forewarnings of storm or frost, such as are now disseminated with promptness and accuracy, would be of great value to the farmer, if available. As a scientific institution devoted to agricultural interests, the Station ought to assist in this plan; and it will be able to do so during the coming year, as soon as its main office is located on the grounds of the Station.

Briefly considered, the more important local meteorological features of the year were the severity of the winter, the favoring warmth and abundant rainfall of the summer season, and the protracted mildness of the fall months. The temperature of January, February and March, was below the average of records kept in Amherst since 1836, while that of February and March was absolutely lower than for any of the corresponding months in this period.*

The first important snowfall of the year occurred January 17, and local sleighing lasted from this time until March 26. The total amount of snow precipitated during these months was 31.68 inches. Melting snow fell April 29, and the surface of the ground froze and ice formed May 4. The last serious frosts occurred May 10, 11, and 12, although a slight frost was noted on lowlands June 10. The following table shows the comparison between the rainfall and temperature of the spring and fall months, arranged in fortnightly periods, and the averages of similar periods for the forty-eight preceding years: —

* See abstract from records of Amherst College, published in the Second Annual Report of the Experiment Station.

	April, Last 15 Days.	May, First 15 Days.	May, Last 16 Days.	June, First 15 Days.	Aug., Last 15 Days.	Sept., First 15 Days.	Sept., Last 15 Days.	Oct., First 15 Days.
Precipitation.								
Average for 48 years,	1.73 in.	2.06 in.	1.86 in.	1.81 in.	2.02 in.	1.46 in.	1.84 in.	1.89 in.
For 1885, . . .	1.78 in.	1.01 in.	2.07 in.	1.61 in.	3.45 in.	0.69 in.	1.01 in.	1.68 in.
Temperature.								
Average for 48 years,	48.6°	57.0°	60.4°	64.9°	67.5°	64.3°	58.0°	52.4°
For 1885, . . .	51.6°	46.9°	61.1°	60.7°	63.2°	59.9°	52.9°	49.1°

The first frost of fall was reported on lowlands, August 27, but no damage was done. Other light frosts followed September 3, 6, 11, and 12. The first killing frost came October 7, but many of the more hardy herbaceous plants were but little injured at the close of this month. In this respect, therefore, the season was favorable; since the records previously referred to show that the average date of the last frost in spring, from 1836 to 1885, was May 16, and of the earliest frost in fall, September 20. The first snow of the winter of 1885–1886 came November 22–26, and amounted to about one inch in depth. December 18 there was a fall of five inches, — a total of six inches for the months of November and December, and 37.68 inches for the entire year.

The prevailing direction of the wind, as taken from the monthly summaries, gives 41.7 per cent. from the south-west, 41.7 per cent. from the north-west, 8.3 per cent. from the north, and 8.3 per cent. from the west.

Rain or snow fell in a measurable quantity on 93 days during the year. The greatest number of such days in any one month was 13, in August; and the fewest 4, in March. Of "clear" days — *i.e.*, those when the sky was less than four-tenths overcast at each observation — there were 63, of which January had the most of any month, 9, and March the fewest, 1.

The "cloudy" days, or those on which the sky was more than seven-tenths obscured at each observation, numbered 69, of which May had the most, 11, and July the fewest, 3.

The remaining 233 days were "fair," having the sky from four to seven tenths obscured at each observation.

The highest temperature of the year was 93.0°, occurring July 9; and the lowest –18.0°, on January 28. From these extremes is obtained the absolute range of temperature for the year; viz., 111.0°.

Miscellaneous Phenomena. — Dates.

	Frost.	Snow.	Rain.	Thunder Storms.	Solar Halos.	Lunar Halos.
January, . .	13, 14, 15, 31.	17, 21, 28.	6, 12, 17.	–	–	–
February, .	9, 13.	1, 5, 8, 10, 14, 16, 18.	9, 16, 25.	–	–	–
March, . .	6.	4, 7, 14, 15, 29.	1, 15, 31.	–	13, 22, 23.	24.
April, . .	15.	12, 29.	4, 5, 7, 12, 26, 28, 29.	–	7, 9, 15, 28.	25.
May, . .	10, 11, 12.	–	1, 2, 8, 14, 18, 23, 30, 31.	–	–	–
June, . .	10.	–	4, 5, 7, 8, 16, 17, 22, 27, 28, 29, 30.	8, 27, 29.	3.	–
July, . .	–	–	2, 3, 4, 5, 6, 7, 9, 10, 14, 21, 26.	2, 4, 9, 21.	13.	–
August, . .	27.	–	1, 2, 3, 4, 5, 10, 11, 13, 18, 19, 21, 22, 23, 24, 25, 30, 31.	1, 3, 5, 17, 22.	–	–
September, .	3, 6, 11, 12, 21, 24.	–	4, 5, 8, 14, 16, 22, 23.	–	22.	20.
October, . .	7, 8, 10, 22, 23, 24, 25, 26.	–	3, 4, 6, 13, 14, 21, 29, 30.	4.	–	–
November, .	3, 14, 16, 18, 20, 21, 27, 28, 29, 30.	22, 23, 24, 25, 26.	1, 2, 5, 6, 7, 8, 19, 20, 25.	–	12, 14.	–
December, .	22, 23, 30.	3, 4, 8, 13, 18.	4, 9, 14, 23, 31.	–	–	–

Summary of Meteorological Observations, 1885.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January,	19.5	26.6	22.4	22.7	33.2	9.4	23.8	57.0	12th	— 18.0	29th	83.9	81.8	79.2	81.7	3 78	15th to 17th.
February,	8.8	20.7	15.6	15.2	25.6	0.1	25 5	44.0	28th	— 15.0	12th	81.6	79.8	83.5	81 7	3.88	8th to 10th.
March,	17.1	29.5	23.3	23.3	32.8	9.1	23.7	50.0	28th	— 11.0	18th	85.4	82 3	87.7	85.3	0.86	29th.
April,	36.8	54.6	45.4	45.3	58.0	29.4	28.6	83.0	22d	19.0	15th	85.5	62.7	69.1	72.6	3.38	28th to 29th.
May,	48.2	62.6	54.1	54.8	65.5	40.1	25.4	85.0	19th	21.0	4th	80.1	61.5	75.1	73.0	3.08	30th to 31st.
June,	56.2	73.2	62.7	63.8	76.0	48.3	27.7	89.0	16th	35.0	10th	89.1	62.7	77.8	76.2	3.49	5th.
July,	63.7	79.8	69.1	70.4	82.9	53.8	29.1	93 0	9th	41.0	2d	88.0	58.9	83.9	77.2	2.07	9th.
August,	60.5	74.6	64.6	66.1	77.0	51.0	26.0	87.0	18th	34.0	28th	90.3	64 7	83.6	79 5	8.31	4th.
September,	49.7	68.3	57.7	58.3	71.0	38.4	32.6	81.0	14th	30.0	12th	94.7	68.3	84.3	82.3	0.85	8th.
October,	42.8	57.8	48.0	49.1	60.1	37.0	23.1	80.0	4th	29.0	8th	95.1	69.2	84 6	82.6	3.65	21st.
November,	35.4	44.3	40.1	39.8	48.3	30.2	18.1	70.0	8th	11.0	29th	93.6	78.3	83.8	84.1	5.54	5th to 9th.
December,	25.3	33 2	30 0	29.6	39.2	18.4	20.8	65.0	10th	6.0	22d	–	–	–	–	3.54	14th.
Sums and means,	38.7	52.1	44.4	44.9	55.8	30.4	25.4	73.7	–	15.2	–	87.9	70.0	81.1	79.7*	42.43	–

* Means of 11 Months.

C. A. GOESSMANN, *Director.*

JAMES P. LYNDE, *Treasurer, in Account with* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1885.	*Receipts.*		1885.	*Expenditures.*	
Jan. 5,	State Treasurer,	$1,250 00		Salaries,	$3,341 07
12,	Dr. C. A. Goessmann, Director,	184 96		Laboratory Supplies,	541 19
April 6,	State Treasurer,	1,250 00		Printing and Postage,	557 08
17,	Dr. C A. Goessmann, Director,	162 87		Office Expenses,	143 71
July 6,	State Treasurer,	3,750 00		Farmer and Farm Labor,	1,275 64
14,	Dr. C. A. Goessmann, Director,	62 72		Farm Supplies,	530 48
Oct. 2,	State Treasurer,	2,500 00		Stock and Feed,	672 13
Nov. 21,	State Treasurer, on account of Agricultural College, for Gas Machine,	566 00		Miscellaneous Expenses,	158 52
				Old Bills, Carpenter and Agricultural College,	1,300 22
				Work about new Laboratory,	218 67
				Expenses Board of Control,	145 05
				Cash in Bank,	840 79
		$9,724 55			$9,724 55

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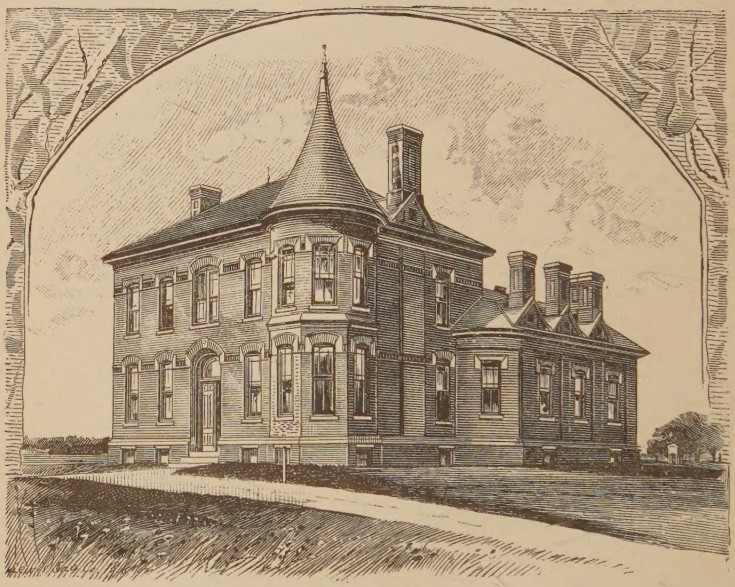

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